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1941	9 percent
1942	11 percent
1943	17 percent
1944	14 percent
1945	22 percent
1946	34 percent
1947	34 percent
1948	60 percent
1949	75 percent

FEBRUARY, 1950

RAILWAY Mechanical and Electrical Engineer

Founded in 1832 as the American Rail-Road Journal.

VOLUME 124 No. 2

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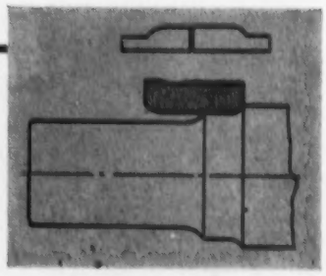

Left: Close-up of hydraulic profile grinding wheel truing attachment. *Right:* Drawing of profile cam and corresponding radius produced on wheel and work. Cams for this installation can be easily interchanged; cover a range of ¾", 1" and 1½" radii.

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Close-up of ground diameters and radii on railroad car axle. One of the loading cradles is shown to advantage in this illustration.

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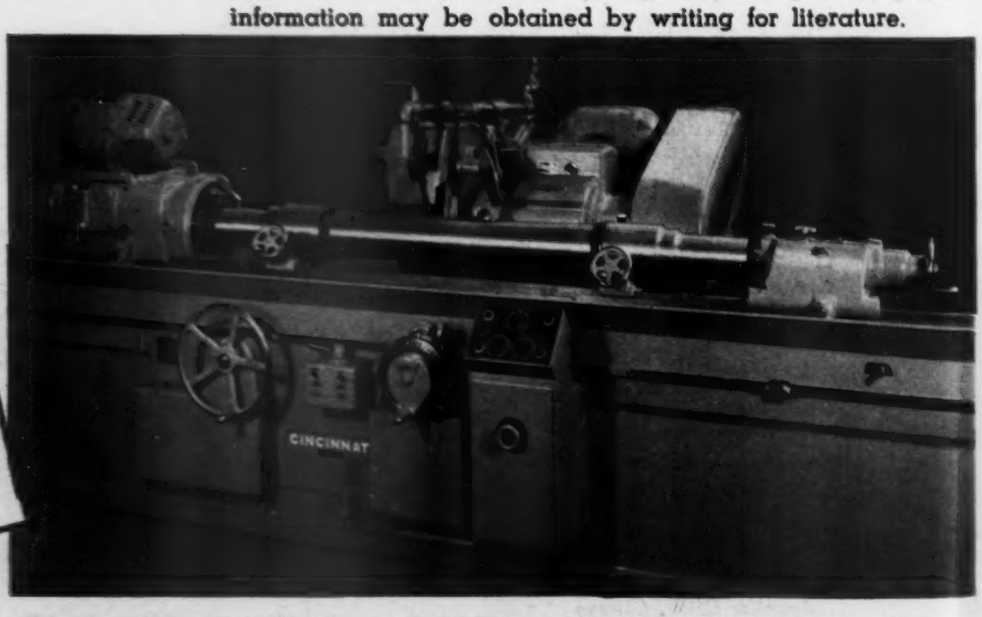

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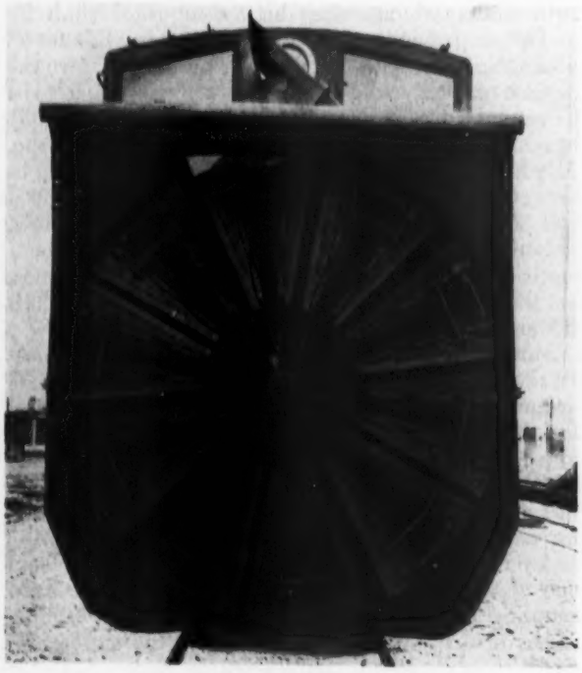
Burlington Applies Diesel Power To Rotary Snow Plow



Old steam plow is converted at Denver shops to electric drive taking power from the leading Diesel pusher unit

An electric rotary snow plow, designed for use in connection with Diesel locomotives, has just been completed ready for winter service on the Chicago, Burlington & Quincy. The new unit is expected to demonstrate advantages because of relatively smooth, quiet operation over exceptionally long distances and periods of time without having to refuel or rewater. While no performance figures are yet available, indications are that the fuel and water range will be extended six to eight times over that of rotary snow plows previously used on this road.

The Burlington plow is 16 ft. high, 36 ft. long, and weighs 91 tons. Constructed at the company shops, Denver, Colo., it utilizes the underframe, trucks, rotor and rotor chute of an old Alco steam plow, but the cab, car body, electrical and mechanical parts are entirely new.

Operating controls and equipment in the cab

Running-board application leading to the cab escape door

The 11½-ft. rotor blades are driven by four Electro-Motive traction motors, two mounted on each of two 8-in. parallel longitudinal shafts which are spur-gear-connected to the central rotor shaft. Standard E-M spur and ring gears for freight service (15 to 62 gear ratio) transmit power from the traction motors to the twin shafts, which drive the central rotor shaft by means of passenger spur and ring gears (25 to 52 gear ratio), two pairs of gears being used to give the desired capacity and reliability without going to a non-standard gear design. All drive and rotor shaft bearings, ten in number, are of the pillow-block type.

A maximum of about 1,080 hp., net, is supplied to the rotor which operates at 130 r.p.m. at plowing speed and 80 r.p.m. when idling. The original steam plow, weighing 100 tons, was equipped with a small locomotive-type steam boiler and two 500-hp. engines, but the total power actually delivered to the rotor shaft seldom exceeded 600 to 800 hp.

Motors in the new design take power through necessary electrical connections from the generator of the first unit of any readily-available four-unit Diesel freight locomotive used as a pusher, the traction motors of this unit being disconnected. All motors on the snow plow are interchangeable with the traction motors of Diesel freight locomotives and can be removed for use in regular service during snowless months.

An E-M 10-kw. auxiliary generator, driven from one of the parallel shafts through a Link-Belt fixed coupling and speed increaser (ratio 4.93 to 1), furnishes field excitation current to give the motors desired constant-speed characteristics under variable load as the plow advances into or backs out of snow drifts. To assure prompt speeding up of the rotor after being stopped, electric current from storage batteries of the locomotive is supplied as required to the motor field circuit.

An ingenious blower arrangement of Burlington design, driven from the other power shaft, furnishes 6,000 cu. ft. of air per min. for cooling the four traction motors, regardless of direction of rotation. This is accomplished by mounting two blowers side by side on the same shaft, one delivering air when the shaft turns clockwise and the other when it turns counter-clockwise. With air delivery from both blowers into the same outlet boot, an automatic damper simply closes the outlet of the blower which is non-operative, dependent upon direction of rotation.

This air for motor cooling is delivered at 2½ in. of water pressure at the motor commutators. The requirement for what is in effect a reversible blower is necessary since the snow plow rotor must be capable of reversal so as to throw snow to either side of the track depending upon which way the rotor is turning and how the deflector plate is set at the top of the chute.

The new steel cab of the plow, which seats two persons in addition to the operator, is thoroughly insulated and kept warm in the coldest weather by a Coleman oil heater. The operator sits on the right side and immediately in front of him are the controller which operates the rotor, recording instruments, and air-brake emergency valve. He is in continuous telephone communication with the engineman of the Diesel loco-

motive who operates from the rear cab. A bell and pneumatic horn are applied to the plow roof just back of the cab.

In addition to driving motors, shafts and gears, the plow body contains electric and resistor control cabinets, tool box, and Mahr portable kerosene torch for melting snow and ice which may accumulate when the rotor is stopped and tend to prevent it from starting again. Both cab and body are snowtight. A Pyle-National 62-volt flush-type headlight is located above the front cab window. This light is installed and wired so that it can be removed from inside the cab. No wiring is exposed.

The original rotor was re-used after being reconditioned and statically balanced. The plow itself was properly balanced by applying 16 tons of steel stampings as counter-weight in a pocket between sills at the rear of the frame.

Features of Electric Drive

Since the electric plow delivers a larger amount of power and more uniform torque to the rotor, shaft, snow and ice formations can be cut and cleared from the track faster than with the steam plow as originally built.

In general, with conventional coal-burning steam plows, a good portion of the time is consumed running for water and coal, cleaning fires, etc., whereas with an abundant supply of fuel oil and double crew there is no reason why the Diesel-electric-driven plow cannot work continuously for a much longer period.

Another major advantage is the relatively low cost through use of standard Diesel locomotive components, such as motors, gear cases, gearing, auxiliary generator, controller, etc., all of which are quickly replaceable from stock in case of damage and all of which can be used in regular train service when the plow is idle during spring, summer and fall months.

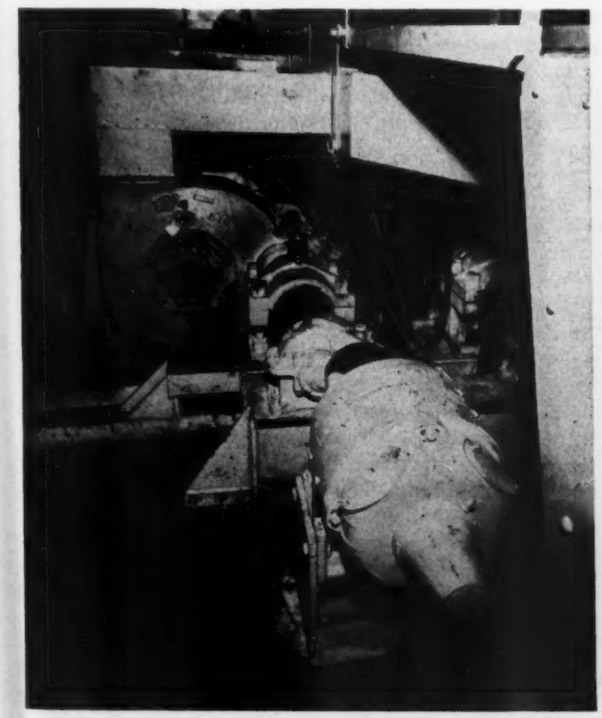
Mechanical and electrical equipment parts are protected from overloads by a circuit breaker set at 1,000 amp. In normal operation, the electrical load is limited to 700 amp. due to the thermal rating of the traction motors. Cables connecting with the Diesel locomotive are completely sealed against weather and passed through the headlight opening of the leading A-unit. Only 30 min. are required for hook-up time.

With electric drive, the rotor is relatively free of vibration and noise, as compared with a steam plow. The multiple driving motors give increased reliability. The four-wheel trucks, suitably reconditioned and applied under the new plow, have 7½-in. by 10-in. journals, 33-in. wheels and 4½-ft. wheel base.

A catwalk is applied over the top of machinery to give access to the cab from the interior of the snow plow. A metal running board on top of the plow body extends from the cab escape door to the ladder at the rear of the plow. Hand rails and ladders meet all safety requirements.

The efficiencies of both the electric plow and the Diesel locomotive are relatively unaffected by severe cold. All vital parts of the plow can be easily reached for maintenance and repair on the road, two doors on each side of the plow body giving ready access to the four driving motors. The plow is painted Omaha orange with black undercarriage and trimmings, the same as other Burlington work equipment.

Auxiliary generator and one of the traction motor installations on the C.B.&Q. rotary snow plow



Two motors installed, the shafts and ring gears for two more motors and the double spur-gear drive to large gears on the central rotor shaft

Evolution of Welded Box Car Design*

PROBABLY less than 30 per cent of our 1¾ million freight cars have any welded joints, and a much smaller percentage are all-welded cars. The first welded freight cars were looked upon with some distrust. Car yards were not in general equipped with welding machines, and hence were unable to repair the welded cars except by substituting rivets for welds. There was considerable reluctance on the part of many carmen to believe that welded joints could endure the severe loads and vibrations encountered in freight service. But the welded cars finally gained acceptance and were recognized as being not only durable but satisfactory equipment. In recent years there has been a rapid swing to welding in preference to riveting.

The Milwaukee Road was a pioneer in building welded cars and in the 13 years since the first cars were built in the railroad's shops, nearly 30,000 freight cars have been constructed, in addition to several hundred passenger cars. The Milwaukee Road was in an enviable position to undertake the construction of welded cars as the shops had never built riveted cars and there was not so much to unlearn, or prejudices to overcome.

Riveting equipment, of course, was available and in use for repairs at these shops but only a limited amount of welding equipment was on hand. It was necessary to acquire the equipment for both arc and resistance welding.

Among the reasons favoring the welding method for building freight cars are a lower assembly cost than a riveted car of the same type once a shop has been suitably equipped, and the elimination of many lap joints that form pockets for collecting corrosive agents such as dirt and moisture. The introduction of welding and the low-alloy high-tensile steels have coincided so that many of the welded cars have been built of the high-tensile steel. The increased corrosion resistance of this steel, as compared to carbon or copper bearing steel, has naturally helped to lengthen the life of the welded car and to decrease the overall weight. Welding and the use of the high-tensile steels have brought the weight down to where the braking problem is a factor in determining the minimum car weight permissible in cars that carry heavy pay loads.

It is important to emphasize here that it is not possible to change from a riveted to a welded design for a car by simply writing on the blueprint, "Weld all joints". It cannot be done and to try is to invite not only economic failure, but other failures as well. Combining both welding and riveting in a single car, whether it be a new car or for repairs, requires care and good engineering. The inherent rigidity of the welded joints may cause an unforeseen distribution of stress and lead to failure of the welds.

* Abstract of a report presented at the 1949 meeting of The American Welding Society by L. E. Grant, engineer of tests, C. M. St. P. & P.

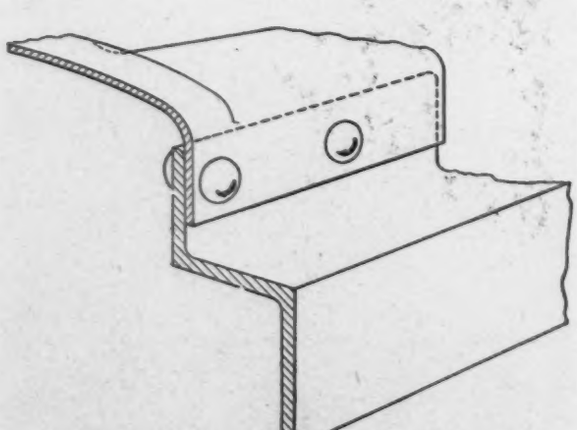


Fig. 1—How the end of the roof sheet is flanged over the side plate—In the welded design the rivets are replaced by a fillet along the flange

Details of Design

The roof consists of a number of 14-gauge galvanized steel sheets 40 in. wide and slightly longer than the car is wide because of the pitch to the roof. A typical method used in riveted car design to make a tight joint between adjoining sheets was to flange up the edges, place a cap over two adjoining flanges and rivet the assembly together. Another method was to rivet a cover strip over a butt joint between two sheets. In both methods ends of the sheet were flanged down over the side plate or upper section of the car side and riveted to it, as shown in Fig. 1.

In changing the roof to a welded design, the cap and rivets were omitted in joining the roof sheets together. The flanged-up edges were hammered together and joined by an edge weld. The entire roof was assembled in a jig so that all the joints could be welded with the workmen standing on the floor. Brackets to hold the running boards were welded to the roof and the interior lining of plywood was installed before the roof was placed on the car. Fig. 2 shows such a roof completed and ready to be lifted by a crane and set in place on the car. Flanges at the edge of the roof extended down over the top plate of the side and were plug welded through rivet holes. Later these rivet holes were omitted and the edge of the flange was fillet welded to the top plate.

This type of roof was difficult to install. It had to be fitted down over the car while still suspended from the crane and a considerable amount of juggling as

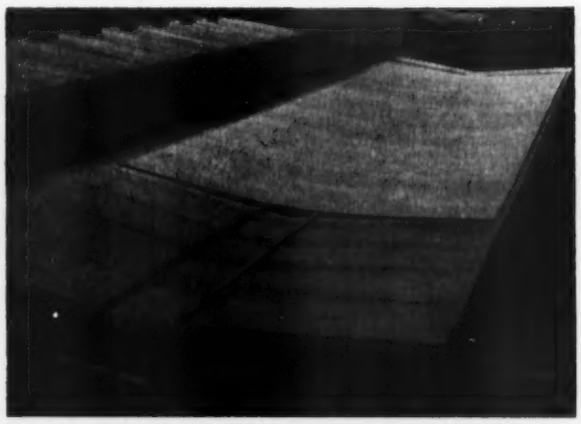


Fig. 2—The welded roof completed and ready to be set in place on the car—A fillet was substituted in later designs for the plug welding through rivet holes shown

well as some hammering and cutting was necessary to finally get it in position. To remedy this an offset was made in the top plate to form a shoulder for the roof to rest on. Then an auxiliary angle, bent to conform to the flanged edge of the roof sheet, was added in the roof jig. This angle was welded in place with fillet welds at the edge of the roof sheets just as had previously been done on the car side. When this type of roof was placed on the car the horizontal leg of the auxiliary roof angle rested on the horizontal section formed in the top plate. Sometimes it was necessary to hammer the contacting leg of the angle down so that a good weld could be made. But the change greatly simplified fitting the roof in place and incidentally increased the capacity of the car. A horizontal fillet weld, entirely around the roof, was required to complete the job. A continuous bead was necessary to make the joint water tight. At first only flat sheets were used in making the roof but later a roof sheet with pressed stiffening panels was used for additional stiffness.

The edge joint of the roof sections were welded with a ⅛-in. Class E-6010 electrode. The weld was started at the center and carried toward the outer edges, welding being slightly down hill. It has been recommended that this joint, at least, be made with a silicon bronze electrode by either carbon arc or metal arc welding to improve the corrosion resistance of the weld. It is true that some of the zinc burns off on the side of the flanges, just below the weld bead, but after twelve years of service no evidence has been found of significant corrosion of either the joints or the sheet adjacent to the joint and hence the higher cost of welding with a non-ferrous rod cannot be justified.

Welding the Ends

In a riveted car the ends consist of two corrugated sections, the upper being lapped over the lower and riveted to it. Ordinarily the top sheet is lighter in gauge than the bottom section because less strength is required near the top. The ends are flanged at the sides to form the corner of the car and these flanges are riveted to the corner posts. The lower edge of the end laps over a transverse end sill and is riveted to it.

Changing this to a welded design was fairly simple. The overlap in the center was omitted as well as the rivet holes, but the difference in thickness between the upper and lower halves was maintained—the top half being 5/32 in. and the lower half 3/16 in., both of low-alloy high-tensile steel. The two halves were assembled in a jig and the butt joint welded with an E-6010 electrode. The completed end with ladder and lumber door is shown in Fig. 3. Later, when a wide door post or pan-type post was adopted, similar wide end posts were also adopted and these were welded into place in the jig, the pans were made a part of the end assembly when it was ready for application to the car. No end sill was used in this construction; the lower edge of the bottom sheet was flanged to form a substitute for the end sill. This flange was welded only at the point where it rested on the center sill and to the side sills. A wood lining was also applied in the final steps of making the ends.

Some of the early welded cars were found to exhibit a tendency for the ends to bulge, especially in the bottom half. This was improved to a considerable extent by changing the depth of the corrugations from 3 to 4 inches.

The All-Welded Sides

Two types of sides are commonly used in riveted cars. There is usually an angle or a pair of angles forming the top plate and a channel or angle at the bottom to form a side sill. These are connected by vertical posts and diagonal braces riveted to the top plate and bottom side sill. One type of car has wood sides bolted to this framework; the other type of car has steel sheets, ordinarily with a vertical lap joint, riveted to the framework.

In our first attempt to make a welded steel side the sheets were welded to the conventional posts and braces without changing the riveted connections at the

Fig. 3—The completed end with the 5/32-in. top section butt-welded to the 3/16-in. lower half

top and bottom. Butt joints between the sheets were welded at the posts. This construction was very unsatisfactory both in appearance and weight.

The next step was to fabricate an all-welded steel side with Zee bar pressings for posts and three rows of wide-flanged U's for horizontal stiffeners, spot welded to the inside of the sheets. The sheets were arc welded at the top and bottom but were spot welded to the posts. The posts were attached to the side sill and to the top plate principally by fillet welds. No diagonal braces were used in this construction, and butt joints between the sheets were arc welded at the posts as before. The sheets were 14-gauge low-alloy high-tensile steel. This type of side was used for a time but was too heavy, showed undesirable warping during construction, and required too many man-hours to make.

The objection to this type of side led to the modification of it shown in Fig. 4. Portal bracing is used at the top and bottom of the door, and the door posts are essentially the same as the other posts. This construction was unsatisfactory as the posts were not strong enough, even with the portal bracing, especially on the automobile type of car having double-width side doors.

Later the posts were changed to a wide pan-shaped section to provide additional strength in the doorway. These wide door posts (and end posts) proved beneficial in other ways. Their use resulted in shortening the side sheets and this made them easier to handle in the shop with the equipment then available. They also strengthened the sides so that it was possible to hang the doors while the side was flat in the fabricating jig. Previously the doors had to be hung on the car after erection was completed. In this construction, the side sill channel was attached to the underframe of the car and did not form a portion of the side proper. An additional section, called a side sill upper element was used to connect the bottom sheet to the side sill channel. This element also served as a support for the ends of the floor boards.

When the completed sides were assembled on the underframe the upper element was pulled down into place against the side sill channel with bolts. Later the bolts were removed and replaced with rivets. This method of construction was not satisfactory because of cracks that ultimately developed between the rivets. The rivet holes in both the upper element and the side sill were omitted and slots were cut in the element so that it could be welded to the top flange of the side sill channel. A few holes were required so that bolts could be used to draw the side down into place on the side sill. This method had a drawback in that it was very difficult at times to bring the upper element down into proper contact for good welding. The side was very stiff in a vertical direction and as the channel was already welded to the underframe it could not be moved very much. To correct this condition the slots were omitted from the upper element and the side sill channel was attached to the upper element by fillet welds on both sides. In this method of construction the side sill channel became a part of the side assembly instead of part of the underframe. The channel was later welded to the underframe when the sides were put in place.

Horizontal Stiffeners Added

The first welded car had flat side sheets, and it was difficult to produce cars without objectionable buckles. Even the U-shaped stiffeners did not help appreciably in reducing the buckles. Experiments were made to determine if some horizontal stiffeners parallel to the length of the sheet could be pressed into the sheets and thus increase the ease of making better appearing sides and at the same time reduce the weight and increase the strength. The plans were to construct the sides by spot welding methods. A comprehensive account of the tests that were conducted, with the above in mind, will be found in a paper by Green and Drinka before the A.S.M.E.*

This type of car side was constructed of 15-gauge sheets (.070 in.) of low-alloy high-tensile steel, and ⅛-in.-thick Z-bar posts of the same material. The door and end pans were 5/32-in. low-alloy high-tensile

* V. Green and J. Drinka, A.S.M.E., October 1945, Page 561.

Fig. 4—An all-welded car side—In later designs, the door posts were changed to a wide pan-shaped section

steel. Although comparatively light in weight these sides had surprisingly high strength. The critical shearing load for a flat 15-gauge sheet with ⅛-in. posts, spaced approximately 2 ft. 4 in. apart, is in the neighborhood of 9,000 lb. When six horizontal bumps were pressed into the sheets, with the sheets overlapping at the bumps, the post spacing remaining the same, the critical shearing load became about 40,000 lb. This is a fourfold increase in strength at the expense of putting in the bumps. Even this load is not the maximum that can be carried.

The size and shape of the bump greatly influences the strength it imparts. Although the sheets may seem thin for a 50-ton capacity box car, actually they may not be stressed beyond 5,000 lb. per sq. in. in service. Much thinner sheets could be used and yet be adequate for strength, but slight corrosion would be very serious.

The side sheet was lapped over and welded to the end pan after the sides and ends had been erected. This weld was made vertical down with an E-6013 sheet metal type of electrode. This joint must be sound and free of pinholes to avoid the possibility of water getting in behind the thin sheet and causing serious corrosion. The weld between the sheet and the door pan was made in the flat position in the side jig where the door, door header, spark strip, route boards, etc., were installed.

The assembly line for car sides has specially constructed spot welders for spot welding the sheets and posts. This latter welder gave a good deal of trouble due to the excessively deep throat involved in welding a car side. This was remedied later by the use of phase-shifting and current controlling equipment. A 40 ft. 6 in. box car required approximately 6,000 spot welds.

Changes in Underframe Design

In building a welded underframe, the two Z-bars welded together along the adjoining edges of two of the flanges were used the same as in a riveted car, although these Zees are not an ideal section for this purpose. In many car plants the Z-bar is joined with a continuous weld made by the submerged arc process from one side only, making a 100 per cent penetration weld although this much welding is not required for adequate strength. In the Milwaukee Shops they were welded manually in a special jig, using an E-6020 electrode, ¼ in. in diameter. They were welded on both sides from each end to beyond the bolsters and then skip welded between these two continuous welds, one weld being inside and the adjacent weld outside.

After the Z-bars had been welded, the center fillers and draft lugs were put in place. In the first welded cars these were castings and were riveted because it was not then known how to weld them successfully. Later castings were made with slots to provide a place for fillet welds. The type of casting used is shown in Fig. 5. All the welding was done on the inside before the center sill was turned over in the erection jig.

During the war when castings were hard to get these parts were fabricated by welding a combination center plate and spider casting to some channel-shaped pieces called cheek plates formed from plate. Instead of making slots in the cheek plates for welding, the slots were cut in the center sill and the welds made from the outside. This was somewhat easier to do than welding the slots in the castings and proved satisfactory. Later the center filler was changed entirely to the weldment shown in Fig. 6. The spider portion (actually the support for the center plate) was made from plate sections welded together. The spider was then welded to channels, which happened to be easier to get than plate, as well as being lighter in weight. This method saved the forming operations involved in making the cheek plates mentioned above. The center plate was forged from a flat disk and welded to the above assembly. The entire welded center filler was then welded to the center sill as before through slots cut in the web of the center sill. Some fillet welds were also used around the edges of the section.

This center filler development has been of considerable interest because of the step-wise progress in changing over to an entirely welded method of construction and the uncertainty and concern over the feasibility of it. On the first castings many more inches of welding than necessary were used because the

Fig. 5—Center-sill casting with slots to provide a place for fillet welds

Fig. 6—The all-welded center filler

magnitude of the impact stresses to which this part would be subjected could not be calculated. Later the amount of welding was reduced and finally, when the change to the fabricated center filler was made, the welding footage was reduced still further. That the decision to reduce the amount of welding was sound has been borne out by the absence of failures in either the center filler weldment or the welds attaching it to the center sill. Some failures of the combination of cast center plate and filler have been experienced but these were due chiefly to improper design and it was 8 to 10 years before these failures became a significant factor in maintenance. The fabricated support for the center plate was not made strong enough and failed vertically. The improved design has shown no signs of failure.

Problems With the Bolsters

In riveted cars the bolsters consisted of two pan-shaped pieces formed from a plate and riveted to the center sill and to the side sill. Riveted cover plates, top and bottom, completed the unit. It was a fairly simple matter to make a bolster by shearing two web plates to take the place of the pans and make a sturdy box section by welding them to separate top and bottom cover plates in a jig. The assembly was then welded to the center sill and side sill. Unfortunately the results were not entirely satisfactory. The structure had ample strength for a bolster but there was considerable tendency for them to break off at the center sill.

To correct the condition, horizontal gusset plates were applied between the bolster and center sill at all four corners. This did not prove satisfactory so a cover plate over the center sill extending out over the bolsters was tried. This helped but did not eliminate failures. Finally the bolster was redesigned to make the top cover plate continuous over the center sill and at the same time the web plates were changed so that they had a wider spread at the center sill than at the side sill. The load of course is much more severe at the center sill connection than at the side sill. Improvements in the jigs and in cutting the web plates provided better fitting joints that could be welded satisfactorily. This type of construction has been in use for about two years and at the present time appears to be reasonably satisfactory but further improvement is anticipated by proposed changes.

The welded cross bearers consist of a top and bottom cover plate with a single web plate fillet welded to them. The top cover plate is not continuous on the cross bearers as the loading is not very heavy and shocks are minor. No trouble has been experienced with the cross bearers or crossties failing.

The methods described herein are those used by the Milwaukee Road. Other railroads and car builders have used other welding methods to accomplish the same results. Some make extensive use of automatic submerged arc welding and do not use spot welds. Various parts in the underframe are made by different methods but the net results are very similar. The type of shop equipment available, the character of the shop buildings and the ideas of the car designer and shop personnel all play a part in how the cars will be built. However, if the welded car is properly engineered and well constructed it will give good service regardless of how the details are worked out.

Seaboard Instruction Car

BECAUSE of the ever-increasing demand for a better understanding of modern Diesel-electric power, the Seaboard Air Line recently inaugurated a Diesel instruction car. This car is moved from one terminal to another over the 4,150-mile system, in order to familiarize employees with up-to-date operating and maintenance procedures.

The structural design and layout of the car, which was built by the Seaboard, make it possible for numerous instructional features to be included in three compact and well-equipped sections. The equipment laboratory displays the complete mechanical and electrical operation of the Diesel-electric locomotive. The classroom section is equipped with 32 comfortable seats, facilities for showing slide and sound motion pictures, and a public address system. A third section serves as the Diesel instructor's office and record room, where all individual attendance records are kept, along with day-by-day classroom progress notes.

The entire instruction car is air-conditioned and well illuminated. Standby cables are carried so that a.c. power may be secured from terminal attachment receptacles to operate motor generator sets, air compressor, and motion picture equipment.

Just about everything that makes up the power unit of the Diesel-electric locomotive is found in the equipment laboratory. A cut-away section of a General Motors 567 engine is shown in detail with the various parts illustrated by a color scheme. The engine revolves on a pedestal so that all parts may readily be seen. Also, there is a Vapor Clarkson steam generator illustrated in cut-away section that shows every detail of operation. The steam generator is electrically operated to demonstrate various safety and control features of steam generation. In addition, several other features are displayed, such as sections of injectors, pistons, rotary blowers, governors, fuel and air brake systems, as well as a complete electrical power plant.

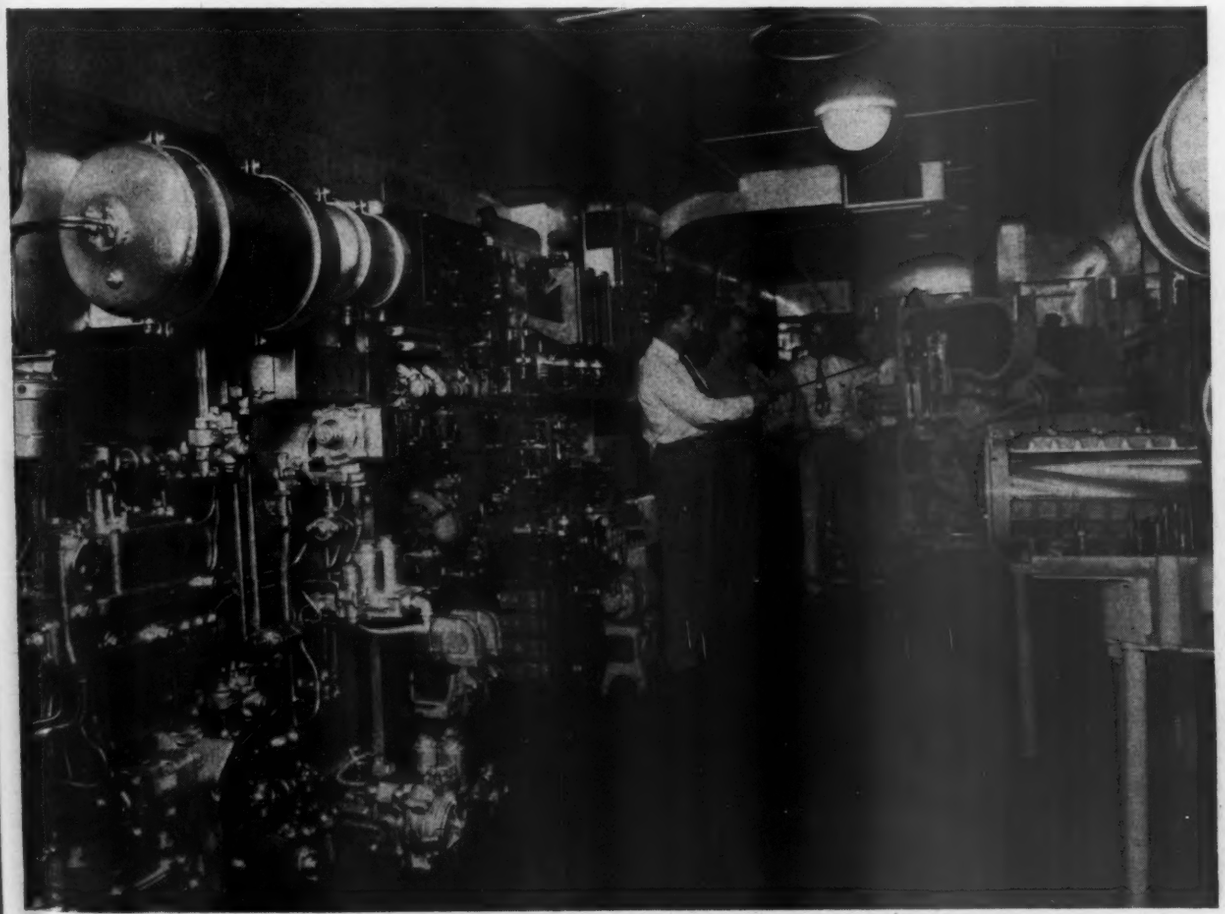
The center of attraction within the equipment laboratory is the cab control station. Here the

instructor or one receiving instruction may sit at the engineman's controls and go through the full procedure of locomotive operation under the same conditions and with the same effects that exist in actual service. This control station is almost a duplication of that found on the Seaboard's new EA-7 locomotives, and functions with the same operating effect. Air brake operation is indicated on the various air pressure gauges; a complete sequence of operation of electrical control can be made and observed on open panels; a speed recorder gives locomotive speed in m.p.h.; a replica of a Mars headlight oscillates and is automatically controlled; warning whistles blow; and many other things function to create the impression of operating a real locomotive.

To stress the importance of safe operation to road personnel, a completely automatic Union Switch and Signal Company coded cab signal has been installed as a part of the control station equipment. These signals function realistically according to train block signals set up by the instructor to typify actual road signal indications. The instructor sets up signals in blocks along a miniature track and by running a toy train along this track to make and break track circuits, cab signals are given that correspond to those within the block.

The various parts within the equipment laboratory are so arranged that the power units can be operated and observed simultaneously from the control station cab. This makes it convenient for the instructor to demonstrate the many air brake and electrical sequences that occur, and also affords an opportunity for road men to operate and, at the same time, observe such operation of these sequences as they actually observe while on the road. Also, the equipment is arranged so that a class of 32 can easily see and hear everything that happens during the demonstration. To afford a better opportunity to see just what is happening during the sequence of electrical contactor operation, a light panel is conveniently mounted at the control station to operate a series of light bulbs that go off and on when contactors make and break. Colored charts of the locomotive parts and operation are mounted on the side walls to give a complete picture analysis of the over-all equipment.

Many interesting discussions take place within the classroom section. New problems are discussed and old problems are reviewed. Answers to many questions that arise are illustrated by slide projectors and motion pictures. The Diesel instructor has a complete study course outlined which begins with basic fundamentals and leads into the more complex problems of Diesel-electric operation.



Automatic Instruments Test Engine Performance

Variety of test instruments, used on both the locomotives and cars, show what goes on in road service

By Joseph Albin

IN an extensive program to improve service and mechanical efficiency, railroads are relying heavily upon recording and controlling instruments to provide data and regulate conditions vital to the many phases of their test work. From this data, the engineers analyze and compare the performances of new and existing power and rolling equipment, fuels and lubricants.

Instruments and control devices are not confined to this test work, but are also contributing to improvements in train service, passenger comfort, and efficiency. These devices range from engine temperature controls and journal temperature alarm systems for Diesel locomotives to air conditioning controls and journal alarm systems for Pullmans and coaches. Refrigeration temperature controls for refrigerator cars are also an important development. As a result, the railroads are finding new ways to attract customers and better to serve them.

Practically every kind of locomotive—steam, Diesel, electric, and gas-turbine—has been under extensive test by various roads. These tests have provided comparative information upon which the selection of future types of locomotive power can be based. Operating data have been established which predict the maximum efficiency of various kinds and types of engines and which aid in selecting the best fuels and lubricants for each type. Tests under the sponsorship of the oil companies are also being made to find the fuels and lubricants which insure the greatest efficiency. Because the majority of these tests are made under operating conditions, with the locomotive and train in motion one factor in the choice of the test equipment has been their capacity to withstand continual vibration and jolting.

Steam Locomotive Tests

Tests on steam locomotives, as on other types, during actual operation are made to determine exact power and efficiency. A typical example of such tests is that made last year by test engineers of the New

York Central on one of that road's Niagara type, Class S-1 locomotives. In these tests, the road operation of the locomotive was analyzed on both fast and slow schedules. Trains of freight cars and trains of deadhead passenger equipment of various sizes, at speeds up to 90 m.p.h. were tested.

To accommodate test personnel and instruments, a dynamometer car was specially constructed in the railroad company's shops. Fig. 2 shows the chronograph table, in the forward end of the dynamometer car, which records, on a moving strip of paper, temperatures, speed, drawbar pull, air pressure in the train line and brake cylinder, revolutions of the stoker engine, strokes of the air pump, and other important operating factors. Fig. 3 shows "ElectroniK" multiple recorders which record various critical temperatures at specific points throughout the locomotive.

Basically, the recorded temperature measurements indicate the heat input to the locomotive, also how much heat is taken out. From the ratio of heat input to output, the efficiency of the locomotive can be determined. By combining temperature values with those of drawbar pull at various speeds and with different loads, an overall analysis of operating efficiency can be obtained. The result is a thorough knowledge of the most efficient loads and speeds at which to operate the engine, what train schedules can be planned, the maximum loads and speeds which can be expected, as well as the capacity of the engine itself.

Exact measurements of temperatures are made and recorded at the following points every 10 seconds by the recorders:

1. Suction or tank water (60 to 85 deg. F.)
2. Water entering locomotive boiler (190 to 270 deg. F.)
3. Exhaust steam temperature in feed water heater (280 to 400 deg. F.)
4. Saturation temperature at dome (410 to 420 deg. F.)
5. Calorimeter (approximately 320 deg. F.)
6. Superheated steam (600 to 760 deg. F.)
7. Smoke box (550 to 740 deg. F.)
8. Over fire (2,000 to 2,720 deg. F.)
9. Over arch (1,700 to 2,200 deg. F.)
10. Combustion chamber (1,400 to 2,000 deg. F.)
11. Exhaust steam temperature from cylinder (280 to 450 deg. F.)

Thermocouples are located at each of the specific points listed above and are connected by extension wires back to the recorders in the dynamometer car. Temperatures are automatically printed on the instrument chart coincident with the switching action of the instrument as it successively contacts the various thermocouple circuits. Inasmuch as the recorders do not employ delicately suspended galvanometer movements, the motion of the train does not interfere with the measuring or recording action. As a result, precise, automatic, continuous records are maintained, and the possibility of human error in the tabulation of values is eliminated.

The automatic type instruments complement the data that is furnished by the visual indicators. Temperatures are recorded at various points every 10 seconds. These short intervals provide a practically continuous record which is not at all possible by the procedure of taking readings every five minutes from the visual indicators. The continuous record of alternations or changes gives what amounts to a more exact picture of performance rather than an average judgment, as would ordinarily be obtained from data taken at longer intervals. Aside from the factor of greater accuracy, the recording instruments can be checked back, which is not the case when readings are taken by the observer and entered on a tabular form. Furthermore, it has been the experience of the engineers that more integrated reports can be developed because of the continuity factor. Readings available at 10-second intervals enable closer and more conclusive connections with data supplied by other instruments in the test.

The automatic instruments may be also compared with the conventional visual indicating instruments with regard to accuracy of calibration. In using the indicating instruments, calibration is stipulated at the end of the day on which tests are made. The element of uncertainty is bound to enter, both as regards the calibrating instruments, the calibrating procedures and the capacity of the instruments themselves after calibration to maintain accuracy. On the other hand, the automatic instruments do not require a comparable amount of calibration due to the accuracy and exactness of the data they supply—a fact which apparently has been borne out by experience.

The automatic instruments provide an extra measure of assurance. The visual indicators are regularly used but the information they provide is taken and studied with data from the automatic continuous recording instruments. This describes the scope and significance of the newer instruments.

Diesel Locomotive Tests and Controls

As in the case of steam locomotives, tests are made on different types of Diesel-electric locomotives to determine the efficiency and capacity under various loads and speeds. Such tests have been performed, for example, by New York Central, Rock Island, American Locomotive Company, and General Motors, Electro-Motive Division. In addition to evaluating the engine efficiency similar tests are used to ascertain the effectiveness of the Diesel engine automatic temperature control system and the effect of various lubricating oils on engine efficiency.

Several factors determine the efficiency of a Diesel engine. Principal among controllable factors are: the latent heat energy in the fuel, the temperature of the engine, and the efficacy of the lubricants (more efficient reduce friction losses, thus allowing more of the latent fuel energy to be transformed into useful mechanical work). Consequently, operating tests have been made to determine the best fuel and lubricating oil characteristics, and also the best types of automatic engine temperature controls.

Illustrative of operating tests to determine the efficiency of engine temperature control is that made on a 2,000-hp New York Central passenger locomotive between Harmon and Buffalo, N. Y. The test was conducted primarily to determine the operating temperatures obtained with automatic engine temperature control. In this test, temperatures were

A variety of indicating and recording instruments are used in test work both on Diesel, and steam locomotives

taken at various points on each of the two 1,000-hp. engines in the A unit of the locomotive. Temperatures at the following points were measured:

(1) Oil temperature into engine; (2) Oil temperature out of engine; (3) Water temperature into engine; (4) Water temperature out of engine, and (5) Ambient temperature inside the locomotive.

From the information thus obtained, the effectiveness of automatic temperature control in promoting the overall efficiency of the locomotive and many design details for such controls were ascertained.

An example of tests made on lubricating oils under actual operating conditions are those currently being made on the New York, Ontario and Western by the Standard Oil Development Company. These tests are being made on a Diesel freight locomotive. The tests involve all phases of engine performance. In these tests four Brown multiple-point recorders are used. Two of these instruments, marked "A unit," are used in conjunction with the forward Diesel engine, and the two others, marked "B unit," are used in conjunction with the rear engine. By means of thermocouples located at certain points on each engine unit, the following temperatures were measured and recorded: (1) On the upper two instruments: oil, radiator, ambient air and fuel temperatures; (2) On the lower two instruments: exhaust gas temperatures. From the temperature data recorded on these four instruments, much basic information on the relationship between lubricating oils and operating conditions has been obtained. From this data, it is possible to develop new and improved lubricants for Diesel engines.

On other roads and for various manufacturers, tests are being carried out (or are expected to be carried out) on gas and steam turbine type locomotives and on electric locomotives. The results of these tests, made on all types of motive power, will largely determine future types.

Railroad Train Control Equipment

The development of various safety control devices has also been a contributing factor to railroad progress, exemplified by the electronic journal alarm system.

A journal alarm system, such as developed by the Minneapolis-Honeywell Regulator Co., is fundamentally a temperature alarm system based upon an electronic bridge circuit. The bridge circuit comprises resistance type thermometer bulbs which are mounted directly in the brass of friction type journals (or in the retainer of the anti-friction type) on each wheel of the car or locomotive. When a rise in temperature above a predetermined setting occurs at any of the resistance bulbs, the resultant unbalance of the electronic bridge causes a relay to operate. Operation of this relay energizes a signal which indicates an abnormal condition of temperature (i.e., a hot box).

The hot journal alarm signals comprise a green light which indicates that the system is in operation, and a red light which flashes on should a hot box occur. Coincident with the occurrence of the visual warning, is an audible alarm. The audible alarm may be in the form of an electric horn or bell, or it may be arranged to actuate a valve in the train signal line.

The entire system is so designed that each of a series of temperature bulbs can be automatically connected into the bridge measuring circuit consecutively. In this way, the temperature of each group of journals is measured periodically, and, in the event of excessive temperature, the proper alarm will be actuated.

Engine Temperature Control

In the operation of Diesel engines, the control of engine temperature is extremely important. To maintain the proper engine temperature automatically, a pneumatic thermostat controls ventilating shutters, which regulate the amount of air passing over the engine radiators, cooling fan speed, and by-pass valves which regulate the flow of engine coolant. In some types of engines, the General Electric eddy-current clutch and the coupling between fan and engine are also automatically controlled.

The components of these various temperature control systems are designed to provide the modulating form of temperature control, and are adaptable to nearly all makes of Diesels. By providing the modulating form of temperature control, an even engine temperature is attained. In this way, optimum engine performance is assured.

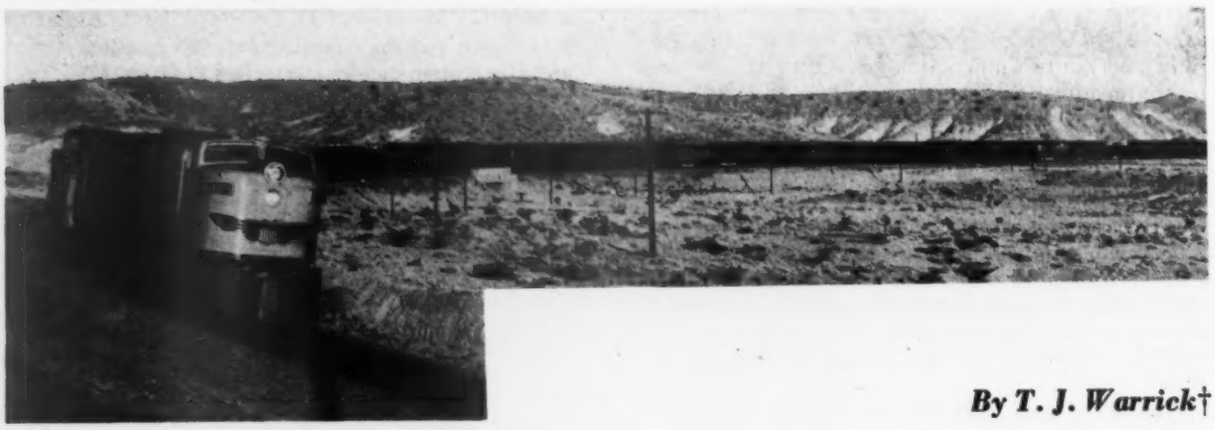
Comfort and Reefer Controls

In line with the railroads' program of improvements in motive power and safety are recent developments which add to passenger comfort and greatly improve the effectiveness of the refrigeration provided for perishables in refrigerator cars. In tests conducted by the Pullman Company, new electronic air-conditioning controls were tested and data assembled which led to sound improvements in car air-conditioning. Standard Pullman air-conditioning equipment was used.

From the results obtained with these tests, air conditioning controls have been designed which eliminate many former passenger discomforts. Such discomforts as the sharp drop in temperature experienced when the steam heat is cut off the cars whenever locomotives are changed, are minimized. Other discomforts like uneven temperature distribution within the car due to sun conditions, and uncomfortable temperature extremes resulting from geographical position or time-of-day, are compensated. By automatically maintaining a relatively even temperature, a more healthy circulation of fresh air can be maintained without causing wide temperature fluctuations. Comfort is achieved equally for window and aisle seat passengers. Thus, the ultimate in passenger comfort is approached. Improvements have also been made in controlling the temperature of refrigerator cars. Thermostatically-controlled heaters now prevent spoilage in refrigerator cars due to freezing. Formerly refrigerator cars of perishables subject to extreme variations of ambient temperature, would freeze, resulting in a partial or total loss of the shipment. By using a small charcoal burner in the ice bunker and controlling its firing by means of thermostatic controls, this problem was overcome.

ELECTRICAL SECTION

Control System for a Gas Turbine Electric Locomotive*



By T. J. Warrick†

A description of the methods and apparatus developed by the General Electric Company to meet the control requirements of this kind of motive power

THIS paper is concerned with the control equipment of the 4,500-hp. Alco-G.E. gas-turbine electric locomotive. It includes a description of the control apparatus and functions, and outlines problems encountered in its application. Control systems relative to this new type of prime mover are dealt with in particular.

The main objective of the gas-turbine electric locomotive development program is the evaluation of the gas-turbine power plant as a prime mover for locomotive use. On this basis, new developments were limited to those peculiar to this type of power plant application. Wherever possible, control equipment comparable to that employed on Diesel-electric road locomotives was used. When chosen, this equipment represented the best possible in design, and it has since proved reliable and successful. Further benefits derived from applying this standard equipment are lower first cost and simplification of the maintenance, servicing, and renewal parts problems.

* Abstract of a paper presented at the Winter General Meeting of the American Institute of Electrical Engineers held in New York, January 30-February 3, 1950.

† Control Engineering Division, General Electric Company.

Propulsion Control

For maximum hauling power in freight service, all eight locomotive axles are driven by series-wound d.c. traction motors. Two motors are powered from each of the four main generators and each system is electrically independent of the others during motoring. Conventional series and parallel connections are used with a single step of field shunting in the parallel connection. Referring to Fig. 1, the "hole" in the speed tractive force curve at the transition point from series to parallel connection of the motors is so small that field shunting in the series connection is not warranted.

Automatic transition, operating as a function of locomotive speed, is provided from series to parallel, and from parallel full field to parallel shunted field. Referring again to Fig. 1, and extending the series and parallel curves at their intersection, it can be seen that for optimum locomotive performance the transfer from series to parallel should occur at 19 m.p.h. The fact that the transfer is automatic relieves the engineman from the responsibility of initiating it at the proper speed, and assures that both forward and

backward transitions will be made correctly. This results in less shock to the train and the electric equipment of the locomotive. Supervisory control is not provided. Smoother forward transition is obtained by transferring four motors at a time. The first four, after completing the cycle, transfer the remaining two generators and their motors. The controls are such that even though one generator is cut out, its associated generator and its motors will transfer. Backward transition is not staggered. See Fig. 2 for motor connections.

Relays in each generator circuit provide ground protection for power and equipment circuits. Disconnects are not provided. In case of fault, one generator and its associated pair of motors are cut out. However, the operation of three generators and their motors continues. These ground relays can be operated manually to cut out any generator, thereby eliminating the need for separate traction motor cutouts.

Controls identical to those on Diesel-electric road locomotives are used for dynamic braking. On this locomotive, however, twice the equipment is necessary since eight motors are used instead of four. Two generators are used to excite the traction motor fields during dynamic braking. Four identical braking resistors are necessary to dissipate the power developed by the traction motors.

Figure 3 shows the power connection diagram for half of the locomotive during braking. The four traction motor exciting fields are tied in series across generator 2. Each pair of motors is connected to one braking resistor and, in effect, become a pair of separately excited generators. By varying the output of the exciting generator, 2, in much the same manner as during motoring, the amount of braking effort is controlled. Figure 4 illustrates the speed-braking effort curve.

The excitation scheme is quite similar to that currently employed on Diesel-electric road locomotives. The main difference lies in the current limit portion of the control. On Diesel-electrics the excitation system provides for limiting generator line and field currents to safe values at the high current and high voltage ends of the characteristic curve, respectively. Since a Diesel engine is essentially a constant horsepower machine at any particular speed, the load control rheostat on the governor is depended upon to limit maximum generator output. This scheme is not suitable for a gas turbine since its power output varies, depending upon the altitude and ambient temperature at which it is operating. It is not practical to design generators and motors to absorb all the available power that the turbine is capable of delivering under ideal conditions. A field-current-biased line current scheme was developed to replace the straight line current feature of the Diesel-electric scheme. This, in effect, limits the line current at the high current end of the characteristic curve and also limits the power at the maximum power portion of the curve, as shown in Fig. 5.

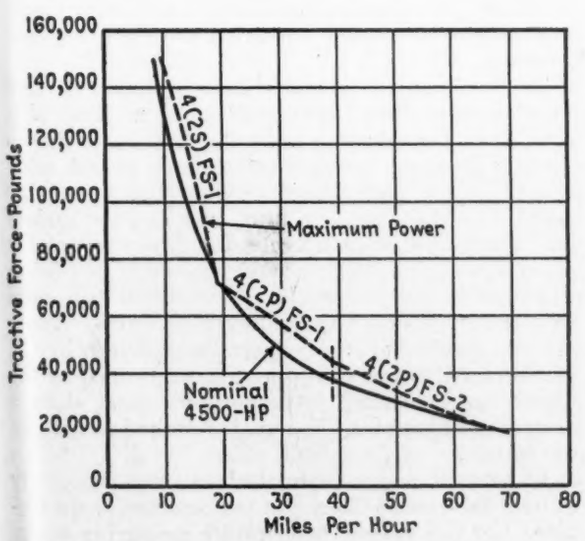
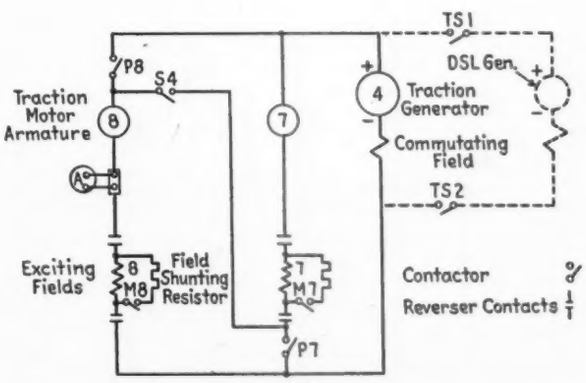


Fig. 1—Speed-tractive-force curve for a 4,500-hp. gas-turbine electric locomotive



Connection	S4	P7	P8	M7	M8
Series FS1	•				
Parallel FS1		•	•		
Parallel FS2		•	•	•	•

Fig. 2—Schematic diagram of motoring connections

Control of power plant speed and generator power demand (locomotive power) is provided in twenty steps on the controller. This number of throttle notches was selected, instead of the customary eight, to give finer and better control of tractive force as well as better locomotive performance when working near limiting adhesion. The throttle handle operates a potentiometer which feeds a d.c. signal into the excitation system of all four generators. By the proper selection of taps on the potentiometer, equal increments of tractive force are obtained. The engineman is prevented from advancing the throttle handle too fast (and consequently making too rapid an increase in power plant speed and output demand) by an "automotoneer". This feature is a mechanical lock on each throttle notch position which prevents the handle from being advanced more than one notch at a time. To advance another notch, it is necessary to retard the throttle handle a half notch and then advance to the next position.

To obtain optimum locomotive performance and to have better control of tractive force, a notching guide in the form of a voltmeter is installed beside

the ammeter on the engineman's panel, (see Fig. 8). This meter is connected across the stabilizing potentiometer of the fuel regulator and, by means of colored band scale markings, indicates the availability of power plant output. The two main divisions of the meter show whether the power plant is operating in either fuel control or load control. When in fuel control, the power plant is capable of developing more output than the load is demanding; but when in load control any further called-for increase in load demand will be nullified by governor action. By watching the amount of generator load reduction, the engine man can govern the rate at which he advances the throttle handle to call for more tractive force.

By means of a switch, located at the engineman's panel, the power plant can be accelerated to, or held at, full speed without power being delivered to the traction motors. With this arrangement, the throttle handle may be manipulated so as to secure the desired tractive force more rapidly and with better control than if part of the power output of the turbine is diverted to accelerating the power plant.

New Control Problems

The application of a gas-turbine power plant as a locomotive prime mover necessitated the development of some new control systems and equipment, and the solution of problems not heretofore encountered. The major new control functions may be grouped as follows:

(1) Power plant control
(2) Power plant cranking and cooldown
(3) Generator power limit

Some of the new components developed for these applications were: a power plant regulator incorporating an electric positioning motor, a magnetic amplifier for controlling this positioning motor, a flame detector system, a voltage regulator for the 400-cycle power supply, an excitation system incorporating a power limit separate from that of the governor, and new control schemes for turbine cranking and cooldown.

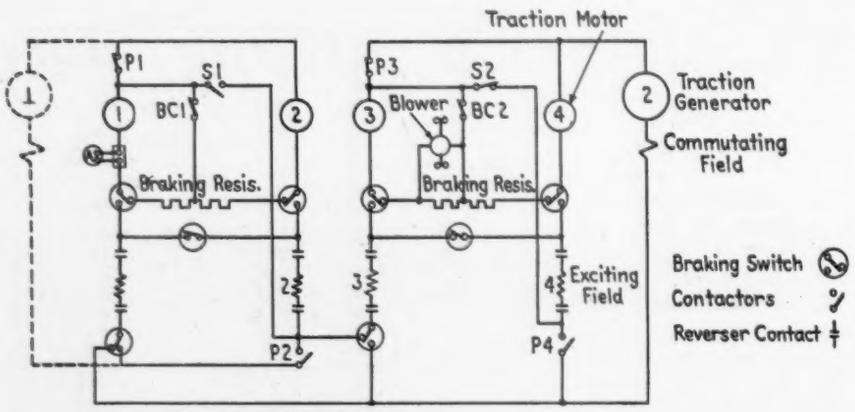


Fig. 3—Schematic diagram of braking connections

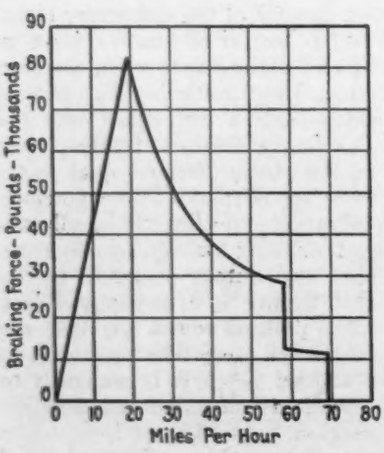


Fig. 4—Speed braking-force curve for a 4,500-hp. gas-turbine electric locomotive

Power Plant Regulator

The power plant regulator or governor is shown in Fig. 6. The functions of the regulating system are to control load and power plant speed; to protect the turbine from excessive exhaust temperatures and overloads; to recognize the ability of the power plant; and to provide remote operation during firing and running.

The basic speed control circuit is similar to that used on many Diesel electric locomotives. Part of it consists of a three-phase tachometer-generator driven directly from the power plant with its output rectified, giving a d.c. voltage proportional to turbine speed. This d.c. signal, in turn, energizes the spring-loaded solenoid which operates the pilot valve of the speed servo. This determines the amount of fuel being delivered to the power plant by hydraulically controlling the position of the wobble plate which changes the effective stroke of a six-port pump driven by the power plant. Power plant speed is determined by the circuit resistance and is proportional to it since a constant current of 0.475 amp. is required to balance the system.

To prevent undue thermal shock, it is necessary to limit the rate of change of temperature in the turbine. For this reason, temperature measuring equipment, consisting of gas-filled bellows located in the exhaust chamber, forms an essential part of the gov-

ernor system. The rate of temperature change is controlled by a rate piston which restricts the rise to 20 deg. F. per second after an initial instantaneous jump of 200 deg. F. A mechanical stop is used to limit the maximum temperature.

Further control of the rate of temperature change is obtained by an electric positioning motor, located within the fuel regulator. This motor is mechanically geared to the speed-setting rheostat, so that its position determines power plant speed. The thermal shock which would result from an instantaneous change in speed (and hence in fuel rate) is lessened by limiting the speed of this motor. In the event of too rapid a change or too high an exhaust temperature, the temperature measuring equipment can reduce the fuel rate called for by the speed control circuit.

During normal running, the positioning motor receives its signals from the voltage taken off a potentiometer operated by the throttle handle. During firing this signal is received from a master rheostat governed by the turbine control switch. Rectified 400-cycle power, controlled by a magnetic amplifier, is used to drive this motor. The voltage at the brush arm of the follow-up rheostat, which is gear-driven by the positioning motor, signals the position of the motor. This brush arm is electrically connected,

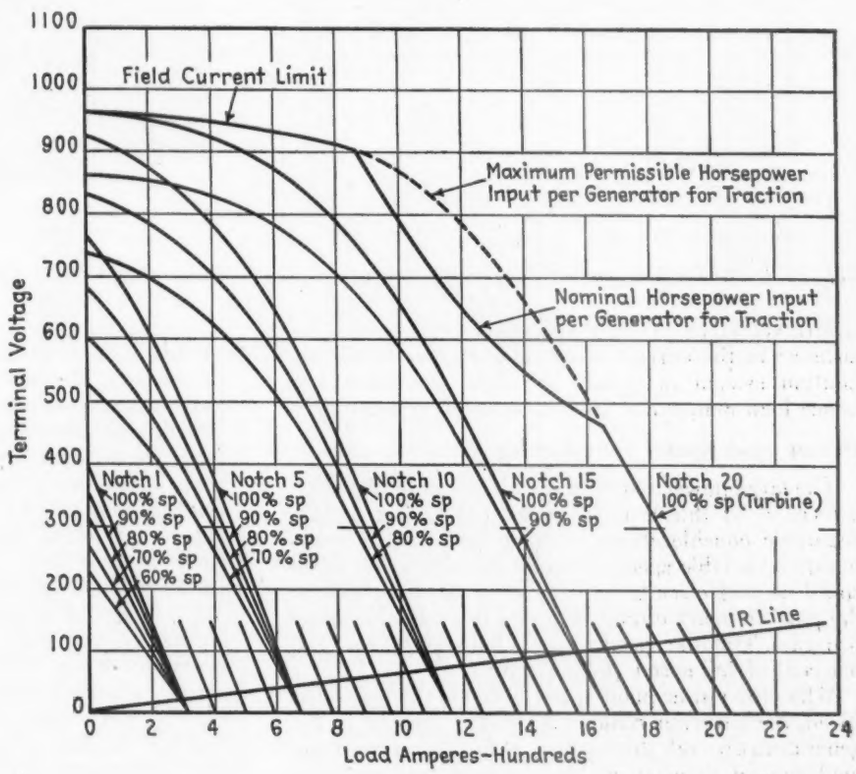


Fig. 5—Traction generator characteristic curves for a 4,500-hp. gas-turbine electric locomotive

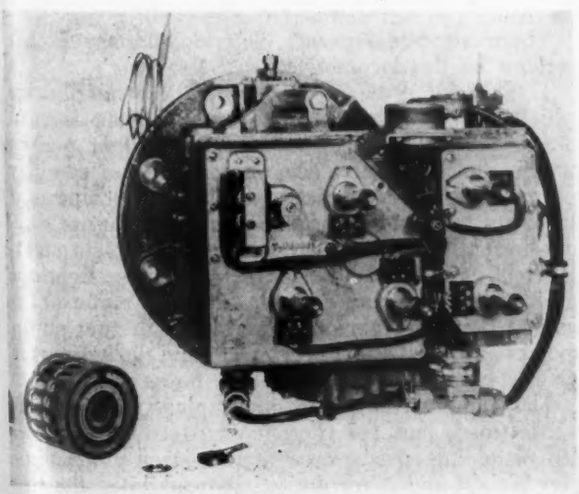


Fig. 6—Power plant fuel regulator

through the windings of two saturable reactors, to the brush arm of whichever potentiometer is controlling speed. With both voltages equal, no current flows and the reactors are balanced. When the called-for speed-voltage is different from that of the follow-up rheostat, current flows through the reactors causing an unbalance in the system. Depending on the direction of current flow, power is supplied to the proper field of a split-pole series d.c. motor causing it to rotate until the system is again balanced.

Under certain conditions, it is necessary to further control the load demand of the traction generators. The feature of the governor which provides for this is similar to the one used on many Diesel-electric road locomotives. With the power plant loaded and the fuel regulator allowing maximum fuel rate (permitted by the aforementioned limits) the speed control portions of the regulator can overtravel and regulate the speed by the control of the generators' output through a load control rheostat. When this

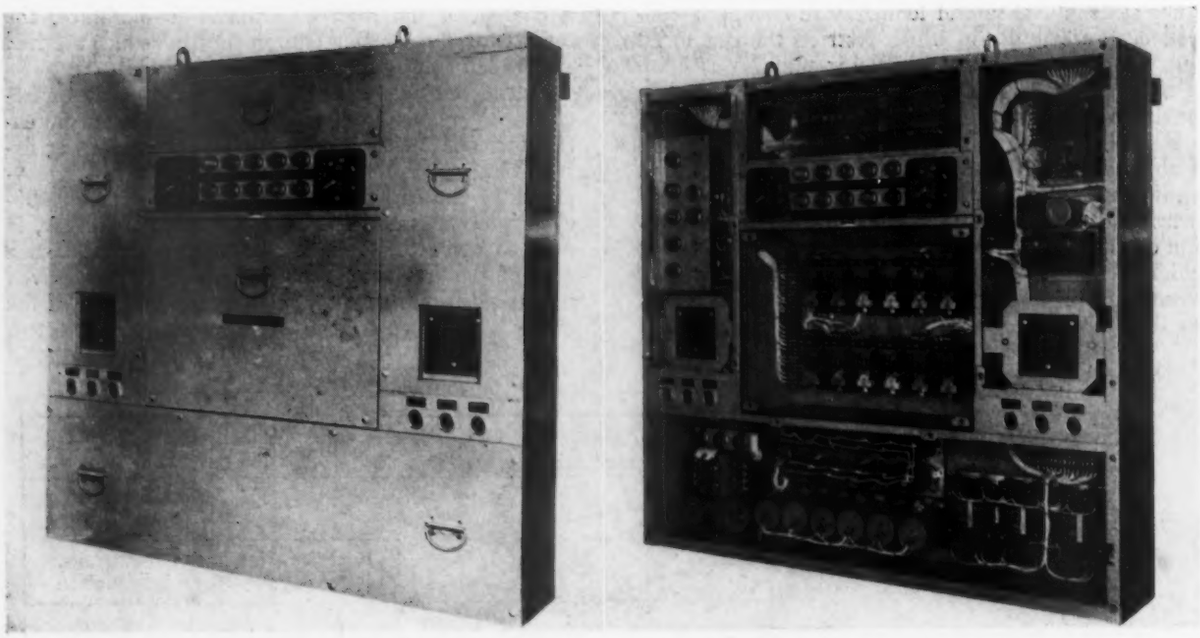


Fig. 7—(left) Turbine control panel with covers—(right) Turbine control panel with covers removed

overtravel takes place, it, in effect, commutates resistance in the current-controlling reactor of the excitation system to reduce the field excitation and hence load demand of all four traction generators.

Power and Speed Scheduling

The large power required for acceleration, the characteristics of this type of power plant, and certain economic considerations made it desirable to incorporate a variable speed schedule into the power plant speed control circuit. A rheostat in the high side of the potentiometer circuit provides this variable speed program. The idle speed range is between 60 and 100 per cent of full speed (6,900 r.p.m.).

When the power plant speed is below the called-for speed, the governor reduces the power demand of the generators through the medium of the aforementioned load control rheostat, making more power available for acceleration. Greater acceleration could be obtained by reducing the power plant output to zero, but then the locomotive would be subjected to sudden shocks of varying power. A compromise is reached by providing 40 per cent reduction in the generator power demand. It is also possible to vary the speed change per notch by the use of a non-linear potentiometer. By having the lower notches produce greater speed changes, better locomotive performance is obtained.

Flame Detector

The function of the flame detector is to hold the fuel valve open as long as fire is sustained in the combustion chambers. The flame detector system includes two sets of thermopiles located in two of the combustion chambers. The d.c. signals produced by them are separately amplified and, with their outputs paralleled, either one can energize a standard control relay to maintain fuel flow to the nozzles. The amplifiers are of the magnetic type with two-stage amplification.

Several problems were encountered in the design of this system. It must be fast enough to detect the presence or absence of fire in the combustion chambers before an excessive amount of fuel can be injected, with consequent damage resulting from high temperature when ignition does take place. To meet these conditions a rugged, yet small-time-lag thermopile was built and so located in the combustion chamber that it is not directly in contact with the fire. Cooling air is directed to provide cold junction within the element as well as necessary general cooling.

In order to obtain satisfactory amplification, a constant a.c. voltage supply was needed. Since 400-cycle power was already available, it was only necessary to provide better voltage regulation. A magnetic type regulator was developed for this purpose which consists fundamentally of a single-stage amplifier and a reference and voltage build-up circuit.

Auxiliary System

There are two separate electric auxiliary power systems on this locomotive.

1. The d.c. system comprises those auxiliaries which must function when the power plant is shut down. A 32-cell battery charged from either one of two identical auxiliary generators furnishes standby power. One generator is driven by the turbine and the other by a Diesel engine which is not in use during normal turbine operation. The power plant starting fuel pump, fuel heat boiler, locomotive lighting, power plant cranking control, 400-cycle motor-alternator set, and the lubricating and water booster pump motors are all required previous to and during power plant starting, and hence are d.c. powered.

The high inertia of the power plant and its connected load, and the time required to crank it to self-sustaining speeds, necessitate a large power supply. Weight and space limitations prohibited the use of batteries as the source of supply, hence an auxiliary

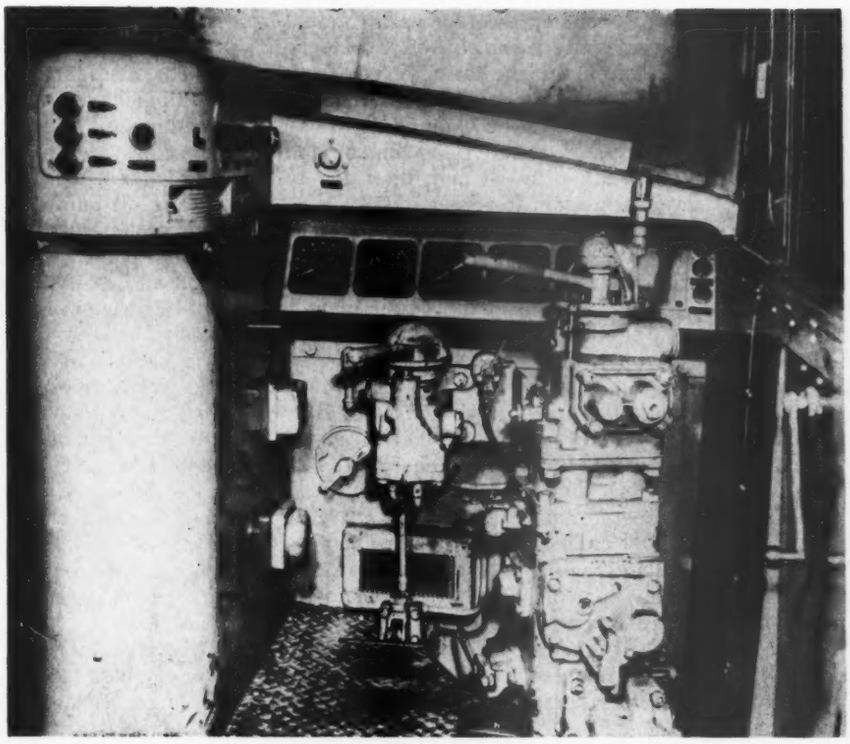


Fig. 8—Engineman's position, showing controls and instruments

Diesel-driven generator set is employed. The Diesel engine is rated 210 hp. at 2,100 r.p.m. and its generator is capable of delivering 140 kw. at this speed. Both turbine-driven and Diesel-driven generators are rated 50 kw. for battery charging.

2. The a.c. system comprises those auxiliaries which function only when the power plant is operating. A three-phase, 80-cycle, 290-volt alternator, driven from the main power plant, provides for operating the following pieces of induction-motor-driven apparatus: four amplidyne exciters, four traction motor blowers, two radiator fans, and the coolant, lubricating, and fuel pumps. Most of these motors are permanently connected to the alternator through circuit breakers. The radiator fan and coolant pump motors are connected through separate contactors (with overloads) which are controlled as a function of lubricating oil temperature.

Power Plant Cracking and Cooldown

Power plant cranking and Diesel control are practically automatic. A three-position Diesel control switch and a five-position turbine control switch are located on the turbine control panel, Fig. 7. This, along with the d.c. circuit breaker panel, is mounted at the side of the power plant. The positions of the Diesel control switch are *Off, Run, Crank;* and those of the turbine control switch are *Off, Crank or Cooldown, Fire and Idle, Bunker C* and *Run.*

Diesel Starting: Before starting the Diesel engine, the water booster pump must be started by closing its circuit breaker and the Diesel and turbine-start circuit breaker must be closed. The control switch is moved to the *Run* position. This allows the throttle operator on the Diesel to advance to idle speed setting. An electric positioning motor drives the speed adjusting shaft of a conventional hydraulic speed-droop governor at proper limited speed. Cam-operated contacts on the throttle operator are used to control the position of the motor. When ready to crank, the Diesel control switch is moved to the *Crank* position and held there. The generator, acting as a series motor powered from the battery, cranks the engine. As soon as the Diesel fires, the switch is released and springs back to the *Run* position. In this position, the Diesel-driven generator is automatically regulated at 75 volts and is connected to the d.c. auxiliary bus for battery charging and supplying the auxiliary load.

Power Plant Cranking: Previous to starting the power plant, the Grade 6 fuel oil is heated to approximately 200 deg. F. by the fuel-heating steam generator.

The Diesel-driven generator is connected to one of the main traction generators for power plant cranking. A conventional self-separate excitation scheme is employed on the Diesel generator, while the traction generator is battery-excited. Since the battery must furnish the d.c. auxiliary power required during cranking and firing, it is necessary to limit the number and length of starts allowed before additional charging is required.

With the proper circuit breakers closed, power plant cranking is initiated by moving the turbine control switch to the *Crank* position. The Diesel engine accelerates to a predetermined speed, simultaneously accelerating the power plant. The control switch may now be moved to the *Fire and Idle* position but fuel injection and ignition will not take place until the minimum speed relay operates at 10 per cent of power plant speed. This relay measures speed indirectly from the rectified output of the turbine-driven tachometer-generator. If the fuel does

not ignite within 45 seconds, the fuel valve is automatically closed and ignition shut off. A time delay relay prevents repetition of the firing cycle for a period of four minutes to allow sufficient time for purging fuel from the combustion chambers. In case of a misfire it is necessary to move the turbine control switch to the *Crank* position and, after the required time delay, back again for firing.

When firing occurs, the flame-detector relay operates and causes the Diesel engine to accelerate to full speed. After firing, a relay introduces a 90-second time delay before the fuel rate of the power plant is increased, thereby allowing the exhaust temperature bellows to become operative. As the power plant approaches idling speed, a reverse-current relay automatically uncouples the Diesel-driven generator from the main traction generator, and the Diesel engine returns to idling speed for battery charging. The Diesel engine may be shut down and the turbine-driven auxiliary generator used for battery charging by moving the Diesel control switch to the *Off* position. The same voltage regulator, overload relay, and reverse current relay control both the Diesel and the turbine-driven auxiliary generators.

Grade 3 fuel oil is used during firing. The transfer to Grade 6 is, at present, a manual operation. As soon as the transfer is complete, the locomotive is ready for service.

Approximately four minutes are required to crank, fire, and accelerate the unit to idle speed. The control of the locomotion of the gas turbine-electric locomotive is quite similar to that of a Diesel-electric road locomotive, as indicated by Fig. 8.

Power Plant Cooldown: Normally, at shutdown the power plant is cranked at low speeds for 15 to 20 minutes. Low power is required for this cranking and hence the Diesel engine is operated at idling speed. It also furnishes power for battery charging during this cooldown period.

Hostler Operation

A means has been provided for moving the light locomotive around yards and terminals without starting the main power plant, by a simple commutation of control circuits. For such movements, the Diesel engine is started in the normal fashion and the hostler control switch is turned to the *On* position. This connects the Diesel-engine driven generator to two of the traction motors in series. The same self-separate excitation arrangement is used for hostler operation as for power plant cranking. Since the Diesel-driven generator cannot be used for battery charging during hostling, the length of time allowable for such movements depends on the condition of the battery and what d.c. auxiliaries are being operated.

The hostler controls the tractive force with the throttle lever indirectly by varying Diesel engine speed. Notch 1 produces tractive force with the Diesel engine at idling speed; Notch 2 holds the speed at which the Diesel engine is operated; Notches from 3 onward cause the Diesel throttle operator to advance steadily to obtain Diesel speeds between idle and full. On level track, the locomotive will attain a speed of about 12 m.p.h.

Six emergency stop switches, one at each engineman's stand and the rest in the engine room, provide means of shutting down the turbine, fuel heat boiler, Diesel engine, and starting fuel pump.

No fuses are used, but all electric circuits and equipment are fed through circuit breakers for protection. All the a.c., and most of the d.c., circuit breakers are for protection only and are normally left closed. The d.c. breakers controlling the lubricating oil pump, the 400-cycle set, the water booster pump, the starting fuel pump, and the Diesel and power plant start breaker are used both for protection and as switches.

Both the power plant and the Diesel engine are protected against overspeed. The overspeed switch on the Diesel engine is part of the governor and mechanically trips the fuel valve. On the power plant, the contacts open to de-energize the turbine stop relay, thereby shutting off fuel and also by-passing the control oil so that the pump goes to zero stroke.

A manually reset, overload relay in the common negative circuit of the Diesel and turbine-driven auxiliary generators provides overload protection for both machines. If the overload trips, field is removed from both generators and the line contactors are de-energized.

Temperature and pressure switches protect the power plant and main reduction-gear unit in case of low lubricating oil pressure and high lubricating oil temperature. The turbine is protected against too high an exhaust temperature by a bellows-operated shutdown switch.

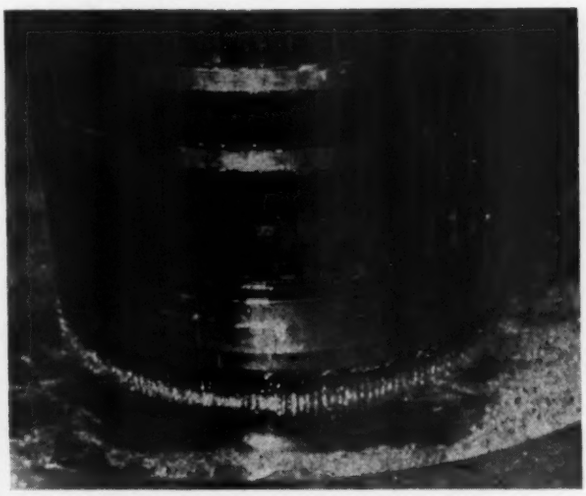
The d.c. lubricating oil pump motor is powered through a contactor which operates as a function of lubricating oil pressure. In cranking the power plant, the d.c. pump furnishes lubricating oil. As the a.c. pump increases in speed, their combined output increases until an oil pressure switch operates and shuts down the d.c. pump. In case the a.c. pump fails for any reason, and the oil pressure drops, the d.c. pump will automatically start before any damage is done to the bearings.

Summary of Tests to Date

Preliminary testing of this locomotive has indicated that the control equipment is basically sound. There have been no troubles encountered to date with the well-seasoned standard equipment used. Little difficulty has been experienced with the new equipment specifically developed for this application. Future testing may result in minor alterations of control equipment; however, no basic changes in the overall control structures are contemplated.

Soldering Commutators

Chicago, South Shore & South Bend finds the dip method of soldering most satisfactory for its soldering of traction motor armatures



Solder flowing to the commutator risers and coil ends

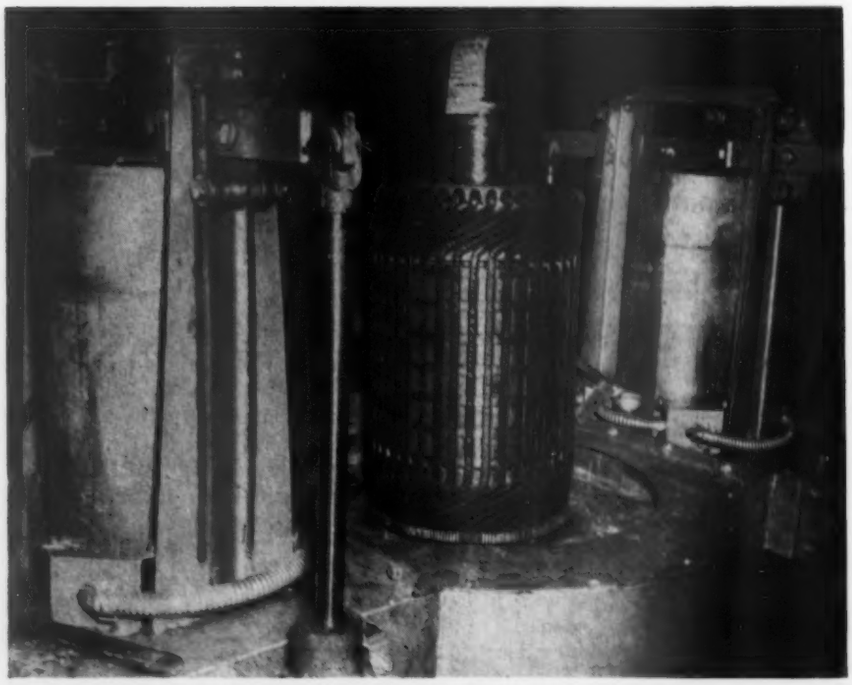
With the increasing number of electric and Diesel-electric locomotives being placed in operation, a major service problem has arisen in the repair of commutators. The length of time involved and the inconsistent results obtained with hand soldering make it desirable that automatic soldering equipment be used.

A double-pot soldering machine of this type, used at the Chicago, South Shore & South Bend shops, has proved the feasibility of soldering traction-motor commutators, in 4 min. each. This machine is completely automatic, and the time required to solder a traction-motor commutator is just 4 minutes. The unit which was developed by the Sunbeam Industrial Furnace Division, Sunbeam Corporation, Chicago, consists of two especially designed melting pots which are electrically heated with immersion electrodes. These pots are of sufficient size to provide a large volume of molten solder at the desired soldering temperature.

An annular cast steel ring is supported on a steel frame directly between the melting furnaces. This ring, as well as each melting pot, has automatic temperature control equipment to control the soldering temperature accurately during the entire soldering cycle. Its diameter is slightly greater than that of the commutator to give sufficient clearance for the commutator and to make it possible to obtain a suitable seal between the commutator and the ring proper.

For smaller commutators, adapter rings are avail-

Sunbeam Stewart automatic double-pot soldering machine



Traction-motor armature up-ended in machine ready for soldering

able which permit the machine to be used for various sizes. These adapter rings are constructed with cast-in immersion-type heaters located near the inner edge. By heating the adapter ring to the soldering temperature, chilling of the solder is prevented. This assures complete soldering of the many segments of the commutator.

Hydraulically operated plungers, automatically controlled with solenoid valves, force the molten solder from the holding pots into the soldering ring. The correct level of the solder in the ring is automatically controlled and maintained during the soldering cycle after which the plungers are released and the solder returns to the holding pots.

The commutator end of the armature after soldering

With this equipment, a commutator can be soldered in 4 min. Using the old methods it took one man from 8 to 12 hours of hand soldering time. The entire operation is controlled by a starting switch. Commutators are preheated, placed in position in the machine, the operator presses a button, and the job is done—automatically. Proper soldering of the slots takes place within 4 min.

Automatic temperature-control equipment holds solder at approximately 720 deg. F. in both melting furnaces and soldering ring. The commutator is first pre-heated from 3 to 12 hr. at 275 deg. F. A heat resistant gasket around the bottom of the commutator forms a seal between the commutator and the adapter.

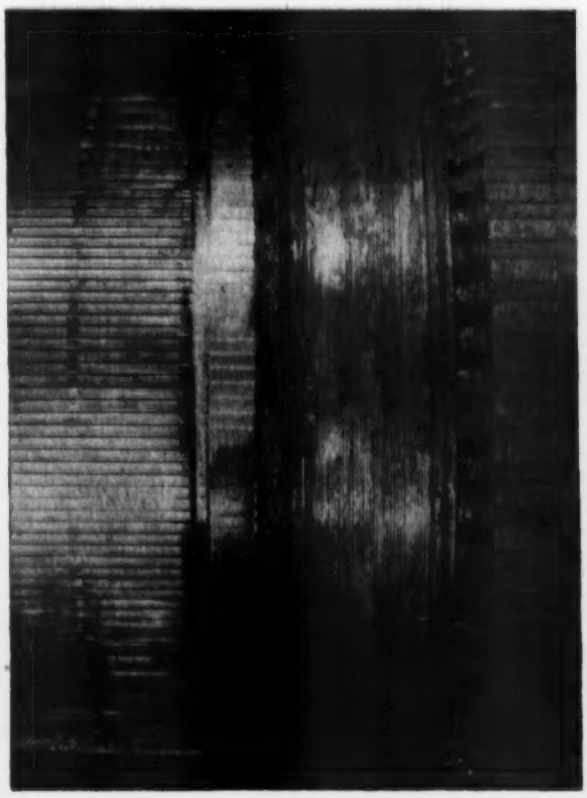
The three factors that affect the quality of soldering throughout the commutator's circumference are automatically controlled in this electric unit. These are the temperature of solder during the cycle, the time of soldering, and the elimination, insofar as possible, of chilling of the commutator during soldering.

The flow of solder evenly and quickly to the desired soldering level is accomplished by means of a circular well adjacent to the annular ring. Solder flows from the holding pots into the well, then overflows evenly toward the commutator. This assures that the entire circumference of the commutator will receive the solder at the same moment. The sealing ring is designed to allow the free flow of solder entirely around the commutator.

Sufficient volume of solder is provided in the unit and kept at the desired soldering temperature to prevent chilling when it comes into contact with the commutator.

One Source of Traction Motor Failure Corrected

By C. F. Steinbrink*



An armature with string bands and compound filler back of the risers.

It has been our experience that a large percentage of traction motor failures showed a definite sign of arcing or burning between top coils just next to the commutator riser and between the commutator end band, and under the string band. The failure was not confined to any particular manufacturer, but was general on all makes and types of motors. The various manufacturers classified this type of failure as flashing at the commutator. When motors were new and there were only a few in service, not much attention was given to this failure. But motors began to multiply by the hundreds, as the mileage of trains became several thousands miles on each trip, and round trips were made without any inspection or maintenance. Under these circumstances, any failure is serious, and every failure has to be analyzed and means taken to eliminate future failures of the same type. It was not uncommon to have ten or twelve failures of this type at the same time. The various manufacturers did not do anything about it, offering the excuse that it was an operating problem. Their excuse, however, did not stop failures.

So, after experimenting and making many different tests, we concluded that the solder was liquifying, and the compound used to fill up the space between the coils was acting as a dam. Since we definitely had signs of solder in the compound, we tried solders that had high melting temperatures; experimented with several makes, and tried several ways of tinning both risers and bar ends. We eventually had good results as far as soldering was concerned, but over a period of time, our failures did not become any less.

An armature on which the filler and string bands have been omitted.

In fact, they became more numerous as speeds, schedules and loads became greater. In the meantime we found that the solder being used was not flexible enough, and we had a great increase in open leads at the riser.

Results Without Compound

During the time we were running these tests, we found that the compound used between the coils and the commutator riser had a tendency to become a very good conductor as the heat was carbonizing the compound, and after trying several different materials and binders, we decided to leave the compound out entirely, which proved to be the answer to this type of failure.

* General Electrical Foreman, Chicago, Rock Island & Pacific.

Leaving the compound out has had several advantages. First, it cuts the cost of rewinds. Second, if the solder does liquify, it is free to throw out as there is nothing blocking its passage. Third, it has cut down, by a large percentage, the number of open commutator risers and last, but most important, it has entirely eliminated the failures caused by the compound carbonizing.

This information was passed on to the various manufacturers, and the compound is being left out by all but one. This manufacturer has changed the compound, but more benefit would be derived if it were left out.

The photos show a before and after condition. One has the compound and string bands, and the other is left open next to the riser. The armature without the compound is an armature that has been rewound. It has been through the impregnator twice, and it may be seen that there is no build-up of varnish next to the riser. It is important that this space be left as free as possible and, to accomplish this condition, a single layer of .007 in. x 1½ in. cotton tape is applied to the outside before it is dipped. After baking it is removed, leaving the space between coils and laminations free of varnish build-up.

Hydrometer and Thermometer Maintenance

Perhaps the two most important tools in the battery room are the hydrometer and thermometer. They indicate the state of charge of the battery and whether it is ready to do a day's work.

The care of the hydrometer and thermometer is simple. It requires only that they be wiped dry and returned to their assigned place after use. They should be kept clean to prevent foreign particles entering the battery. Occasionally, the hydrometer should be taken apart, the float and the inside of the barrel cleaned, and the float examined for defects.

As important as the care of this equipment, is its correct use. When using the hydrometer, the rubber nozzle is placed into the battery vent opening, and enough electrolyte drawn into the barrel to permit the float to ride freely, not touching the barrel at any point. The hydrometer is held in a vertical position, and read with the eye level at the electrolyte mark. If the hydrometer must be removed from the vent for reading, the nozzle should be pinched tightly or a gloved finger placed against the opening to prevent dripping of electrolyte. The float is read at the electrolyte level, disregarding the curvature of the liquid.

Correction of specific gravity must be made on the basis of plus or minus three points of gravity for each 10 deg. F. (electrolyte temperature). Using 77 deg. F. as a base, three points of gravity are added for each 10 deg. F. above base, and three points subtracted for each 10 deg. below.

This correction is necessary to obtain accurate specific gravity readings. As the temperature of the acid rises, the acid expands and is, therefore, not as dense. The float then rides low, giving readings lower than normal. Conversely, when the acid is cold, the float rides high and the reading is higher than normal. The following are examples of how this correction factor is applied.

Hydrometer Reading	Thermometer Reading	Correction	True Sp. Gr.
1.250	87 deg. F.	plus 3	1.253
1.210	80 deg. F.	plus 1	1.211
1.180	64 deg. F.	minus 4	1.176

Some thermometers, specially designed for battery

Accurate hydrometer readings require that the instrument be held vertically so that the float does not touch the barrel
Courtesy of Gould Storage Battery Corporation

application, are scaled to permit ready correction of gravity readings. Adjacent to the regular temperature scale is a second column of figures, preceded by a "plus" sign above 77 deg. F. and a "minus" sign below. Reading the figures at the mercury level ascertains the amount of correction necessary. Thus, if the hydrometer reading is 1.260 and the second scale on the thermometer indicates plus 8, the true specific gravity is 1.268.

When unpacking a new hydrometer, rubber bulb, glass barrel, rubber nozzle, and float should be checked for breaks or cracks. Any dirt or packing material should be washed from the parts to prevent any foreign material from getting into the electrolyte. The large end of the rubber nozzle slips into the glass barrel, being securely held in place by tension of the rubber in the barrel. To facilitate insertion of the nozzle, the rubber and glass should be lubricated with plenty of water. The rubber bulb can be attached in the same manner. It is advisable to wear gloves when assembling the hydrometer as there is always a possibility of glass breakage.

Traction Motor and Generator Maintenance*

The question of traction motor maintenance should be approached from the standpoint of what is done to a motor under the locomotive. The manufacturers are making great strides in improving the parts of a traction motor, with the ultimate aim of having a motor that will go from shopping to shopping with the minimum of attention. This aim is of advantage to the railroads as any work done to a motor on the locomotive is performed under severe handicaps due to dirt and close clearances.

Brushes are still very much of a live subject, with the manufacturers and railroads working together in developing and testing. Up to 180,000 miles' life has been obtained with some brushes.

Lubrication of armature bearings has been a topic of investigation with high priority. The well-known advantages of oil lubrication for anti-friction bearings are available as the problems of supplying and retaining the oil have been reduced. Greases of far superior characteristics are appearing and offer considerable promise of reducing or even eliminating this item of running attention.

A very important factor in successful operation of traction motors is careful attention to determination of tonnage ratings. A necessary part of this is proper education of operating department personnel so that established ratings are not exceeded. The engineer, the yardmaster and the trainmaster are the ones most immediately concerned.

* Abstract of a paper presented by the Diesel-Electrical Committee at the Annual Meeting of Locomotive Maintenance Officers' Association, held at the Hotel Sherman, Chicago, Sept. 19-22, 1949.

Mileage Between Overhauls

The mileage at which basic overhaul of traction motors and main generators become due is determined by three factors: (1) The care the equipment receives between overhauls such as inspection, cleaning and running maintenance; (2) The life of the bearings; (3) Economical cost of repairs. This item requires careful investigation and good judgment in view of the comparatively short experience. In general, there is a certain length of time between overhauls beyond which the overall cost will tend to rise.

With proper routine maintenance, the present life of anti-friction bearings and balanced economics on repairs, the basic overhaul of equipment should be:

Traction motors:	Passenger	300,000 miles
	Freight	200,000 miles
	Switch and transfer	4 years
Main generators:	Passenger	1,250,000 miles
	Freight	1,250,000 miles
	Switch and transfer	7 years

As a rule, it is wise not to disturb field coils any more than necessary as the insulation does better if left alone. It is recommended that field coils be removed as follows:

Traction motors:

Passenger	Every second basic overhaul
Freight	Every third basic overhaul
Switch or transfer	Every second basic overhaul

Main generators:

All services	Every basic overhaul

The procedure for overhauling traction motors and generators varies somewhat on different roads but the production line method is the fastest and most economical.

Maintenance Procedure

In repairing or rewinding traction motors, it cannot be emphasized too strongly that precise and rigid attention to details is of utmost importance. Care and skill enter into the placing of coils in the slots and every step that follows plays an important part in insuring adequately insulated windings that are truly supported so that subsequent movement is not possible. A slight slip at any one point in the process may result in short life and troublesome road failures.

The assembly of armature shafts and bearings into the frame is another operation which calls for scrupulous attention to cleanliness and proper clearance. These bearings are designed for operation with the load properly distributed between rollers and over the entire length of individual rollers. Too little clearance invites the risk of locking when warmed up, while too much clearance does not divide the load over enough rollers. A slight misalignment may cause point instead of line contact and exceed the strength of the metal.

Some roads are finding it desirable to pull generators at every opportunity so as to do a thorough job of cleaning around the fan end. Dirt will accumulate around the coils and this invites insulation troubles if allowed to remain. The dirt also obstructs flow of cooling air. It is very difficult to remove even with special air nozzles and drilled fans. The trend in locomotive design toward pressurized engine compartments with filtered air offers promise of solving this particular headache.

Diesel Locomotive Repair Shops

THE tabulation indicates the class of repair work performed on Diesel-electric locomotives at 280 repair points on 69 railroads. These roads operate 95 per cent of the Diesel locomotive units on Class I systems, and nearly 90 per cent of those on all U. S. railroads.

Reports were received from 61 railroads. However, reasonably reliable information was available for eight other roads and therefore data regarding their Diesel repair facilities is included.

Several railroads indicated that some of the shops were built exclusively for Diesel work and that other shops are steam installations also performing Diesel work.

Other roads did not include repair points that maintained only Diesel switching locomotives. One road reported that it had a large number of small outlying points which perform running repairs on one or more Diesel switchers. These are not included on the list.

The development of Diesel repair facilities is in an embryonic stage. There have been some complete new Diesel shops built, but many roads still confine Diesel maintenance largely to running repairs, and rely on the locomotive builder for replacement parts and for heavy repairs on a unit exchange basis.

This is understandable in view of the increase in the utilization of Diesel locomotives since 1939. In that year Class I railroads operated 566 Diesel locomotive units which consumed 48 million gallons of Diesel fuel. In 1949, the number of Diesel locomotive units had grown to nearly 10,500—an increase of more than 1700 per cent; and the consumption of Diesel fuel during 1949 should total about 1.6 billion gallons—an increase of more than 3000 per cent.

The most rapid increase in the installation of Diesel road locomotives has been in the last few years, and consequently a large number of such locomotives are new. It is also true that Diesel power has introduced maintenance problems that are new to railroad men, and most mechanical officers have not as yet had the time nor adequate data thoroughly to analyze the shop facilities necessary for providing heavy mechanical and electrical Diesel repairs on an efficient basis.

In view of this, most roads have been reluctant to spend large sums on new, complete Diesel repair shops and have preferred to adapt existing facilities to Diesel repairs wherever possible. However, the continuing rapid growth in the installation of new Diesel road locomotives, and the accumulating experience in maintaining such motive power will encourage the building of many new, efficient Diesel repair shops, not only to provide additional repair facilities but also to provide modern shops for Diesel work now performed in steam locomotive shops and engine houses.

Class of Work Performed in Diesel Locomotive Repair Shops

LOCATION OF SHOP			RUNNING REPAIRS		HEAVY REPAIRS			
					Mechanical		Electrical	
Railroad	City	State	Mech.	Elec.	Engine Overhaul	Wheel Work	Excluding Armature Winding	Including Armature Winding
Akron, Canton & Youngstown	Akron,	Ohio	★	★	★	—	★	—
A. T. & S. F.	Argentine,	Kans.	★	★	—	★	—	—
	Barstow,	Calif.	★	★	—	★	★	—
	Chicago,	Ill.	★	★	★	★	★	—
	Chicago (Corwith Yd.),	Ill.	★	★	—	—	—	—
	Cleburne,	Texas	★	★	★	★	★	—
	San Bernardino,	Calif.	★	★	★	★	—	★
	Topeka,	Kans.	★	★	★	★	★	—
	Winslow,	Ariz.	★	★	—	★	—	—
Atlanta & St. Andrews Bay	Panama City,	Fla.	★	★	★	—	★	—
Atlanta & West Point—W. of A.	Montgomery,	Ala.	★	★	—	★	★	—
Atlantic Coast Line	Jacksonville,	Fla.	★	★	—	—	★	—
	Waycross,	Ga.	★	★	★	★	—	—
Baltimore & Ohio	Baltimore (Mt. Clare),	Md.	★	★	★	★	★	—
	Baltimore (Riverside),	Md.	★	★	—	—	—	—
	Chicago (Chicago Term.),	Ill.	★	★	—	—	—	—
	Cinti. (Stock Yards),	Ohio	★	★	—	—	—	—
	Cone,	Ill.	★	★	★	—	—	—
	Philadelphia,	Pa.	★	★	—	—	—	—
	Pittsburgh,	Pa.	★	★	—	★	—	—
	Punxsutawney,	Pa.	★	★	—	—	—	—
	Washington (Wash. Term.),	D. C.	★	★	—	—	—	—
	Willard,	Ohio	★	★	—	—	—	—
Boston & Maine	Billerica,	Mass.	—	—	—	★	★	—
	Boston,	Mass.	★	★	★	—	—	—
	Mechanicville,	N. Y.	★	★	★	—	—	—

Class of Work Performed in Diesel Locomotive Repair Shops—(Continued)

LOCATION OF SHOP			RUNNING REPAIRS		HEAVY REPAIRS			
					Mechanical		Electrical	
Railroad	City	State	Mech.	Elec.	Engine Overhaul	Wheel Work	Excluding Armature Winding	Including Armature Winding
Canton Railroad	Baltimore,	Md.	★	★	—	—	—	—
Central of Georgia	Macon,	Ga.	★	★	★	★	—	★
Central RR of N. J.—C. RR of Pa.	Bethlehem,	Pa.	★	★	★	★	—	—
	Elizabethport,	N. J.	★	★	★	★	★	—
	Jersey City,	N. J.	★	★	—	—	—	—
Chesapeake & Ohio (Pere Marquette Div.)	Chicago,	Ill.	★	★	—	—	—	—
	Detroit,	Mich.	★	★	—	—	—	—
	Flint,	Mich.	★	★	—	—	—	—
	Grand Rapids,	Mich.	★	★	★	★	★	—
	Holland,	Mich.	★	★	—	—	—	—
	Muskegon,	Mich.	★	★	—	—	—	—
	Ottawa (Erie),	Mich.	★	★	—	—	—	—
	Plymouth,	Mich.	★	★	—	—	—	—
	Port Huron,	Mich.	★	★	—	—	—	—
	Saginaw,	Mich.	★	★	★	—	—	—
	Traverse City,	Mich.	★	★	—	—	—	—
Chi. & Eastern Illinois	Danville,	Ill.	★	★	★	★	★	—
	Evansville,	Ind.	★	★	★	—	—	—
	Mitchell,	Ill.	★	★	★	—	—	—
	Terre Haute,	Ind.	★	★	★	—	—	—
	Yard Center,	Ill.	★	★	★	—	—	—
C. & N. W.—C. St. P. M. & O.	Chicago,	Ill.	★	★	★	★	—	★
	Clinton,	Iowa	★	★	★	—	—	—
	Council Bluffs,	Iowa	★	★	—	—	—	—
	Green Bay,	Wis.	★	★	★	—	—	—
	Milwaukee,	Wis.	★	★	★	—	—	—
	Minneapolis,	Minn.	★	★	—	—	—	—
	Proviso (Frt. Locos.),	Ill.	★	★	★	—	—	—
	St. Paul,	Minn.	★	★	★	★	—	—
Chicago, Burlington & Quincy	Chicago,	Ill.	★	★	—	—	—	—
	Clyde,	Ill.	★	★	—	★	—	—
	Denver,	Colo.	★	★	—	—	—	—
	West Burlington,	Iowa	★	★	★	★	—	★
Chicago Great Western	Oelwein,	Iowa	★	★	★	—	—	—
Chi., Indianapolis & Lville.	Lafayette,	Ind.	★	★	★	★	★	—
C. M. St. P. & P.	Chicago,	Ill.	★	★	★	★	—	—
	Milwaukee,	Wis.	★	★	★	★	—	★
	Minneapolis,	Minn.	★	★	★	★	—	—
	Mitchell,	S. D.	★	★	—	—	—	—
	Othello,	Wash.	★	★	—	—	—	—
	Savanna,	Ill.	★	★	—	—	—	—
	Tacoma,	Wash.	★	★	★	★	—	★
	Wausau,	Wis.	★	★	—	—	—	—
Chicago, Rock Island & Pac.	Cedar Rapids,	Iowa	★	★	★	★	—	—
	Chicago,	Ill.	★	★	—	—	—	—
	Des Moines,	Iowa	★	★	—	—	—	—
	El Reno,	Okla.	★	★	★	—	—	—
	Kansas City,	Kan.	★	★	—	★	—	—
	Memphis,	Tenn.	★	★	—	—	—	—
	Minneapolis,	Minn.	★	★	—	—	—	—
	Peoria,	Ill.	★	★	—	—	—	—
	Silvis (Diesel Shop),	Ill.	★	★	★	★	—	★
	Silvis (Diesel Frt. only),	Ill.	★	★	—	—	—	—
Clinchfield Railroad	Erwin,	Tenn.	★	★	—	★	—	—
Delaware & Hudson	Watervliet (Colonie),	N. Y.	★	★	—	—	—	—
Delaware, Lackawanna & Western	Scranton,	Pa.	★	★	★	—	★	—
Denver & Rio Grande Western	Denver,	Colo.	★	★	★	—	★	—
Detroit & Mackinac	Tawas City,	Mich.	★	★	★	★	—	—
Detroit, Toledo & Ironton	Flat Rock, (Flat Rock Yard)	Mich.	★	★	★	★	—	—
Duluth, So. Shore & Atlantic	Marquette,	Mich.	★	★	★	★	—	—
Elgin, Joliet & Eastern	East Joliet,	Ill.	★	★	★	★	★	—
	Gary,	Ind.	★	★	★	—	★	—
Erie	Akron,	Ohio	★	★	—	—	—	—
	Brier Hill,	Ohio	★	★	—	—	—	—

Class of Work Performed in Diesel Locomotive Repair Shops—(Continued)

LOCATION OF SHOP			RUNNING REPAIRS		HEAVY REPAIRS			
					Mechanical		Electrical	
Railroad	City	State	Mech.	Elec.	Engine Overhaul	Wheel Work	Excluding Armature Winding	Including Armature Winding
Erie (cont'd)								
	Buffalo,	N. Y.	★	★	★	—	★	—
	Cleveland,	Ohio	★	★	—	—	—	—
	Hammond,	Ind.	★	★	★	—	★	—
	Hornell,	N. Y.	★	★	—	—	—	—
	Jersey City,	N. J.	★	★	—	—	—	—
	Kent,	Ohio	★	★	—	—	—	—
	Marion,	Ohio	★	★	★	★	★	—
	Meadville,	Pa.	★	★	—	—	—	—
	Port Jervis,	N. Y.	★	★	—	—	—	—
	Salamanca,	N. Y.	★	★	—	—	—	—
	Secaucus,	N. J.	★	★	—	—	—	—
Florida East Coast	Miami (Buena Vista),	Fla.	★	★	—	—	★	—
	St. Augustine,	Fla.	★	★	★	★	—	—
Grand Trunk Western	Battle Creek,	Mich.	★	★	★	★	★	—
	Chicago,	Ill.	★	★	—	—	—	—
	Detroit,	Mich.	★	★	—	—	—	—
	Durand,	Mich.	★	★	—	—	—	—
	Flint,	Mich.	★	★	—	—	—	—
	Grand Rapids,	Mich.	★	★	—	—	—	—
	Pontiac,	Mich.	★	★	—	—	—	—
	Port Huron,	Mich.	★	★	—	—	—	—
	Milwaukee,	Wisc.	★	★	—	—	—	—
Great Northern	Appleyard,	Wash.	★	★	—	—	—	—
	Delta,	Wash.	★	★	—	—	—	—
	Fargo,	N. D.	★	★	—	—	—	—
	Grand Forks,	N. D.	★	★	—	—	—	—
	Great Falls,	Mont.	★	★	—	★	—	—
	Havre,	Mont.	★	★	★	—	—	—
	Hillyard,	Wash.	★	★	—	★	—	—
	Interbay,	Wash.	★	★	—	—	—	—
	Klamath Falls,	Ore.	★	★	—	—	—	—
	Minot,	N. D.	★	★	—	—	—	—
	St. Paul,	Minn.	★	★	★	★	—	★
	Sioux City,	Iowa	★	★	—	—	—	—
	Superior,	Wis.	★	★	—	—	—	—
	Whitefish,	Mont.	★	★	—	—	—	—
	Williston,	N. D.	★	★	—	—	—	—
	Willmar,	Minn.	★	★	—	—	—	—
Green Bay & Western	Green Bay, (Norwood Shops).	Wis.	★	★	★	—	—	—
Gulf, Mobile & Ohio (Incl. Alton)	St. Louis,	Mo.	★	★	—	—	—	—
	Venice,	Ill.	★	★	—	—	★	—
Illinois Central	Chicago (Burnside),	Ill.	★	★	★	—	—	★
	Chicago (27th St.),	Ill.	★	★	—	—	—	—
Illinois Terminal	Madison,	Ill.	★	★	—	—	—	—
Kansas City Southern	Pittsburgh,	Kan.	★	★	★	★	★	—
	Shreveport,	La.	★	★	★	—	—	—
Lehigh & New England	Pen Argyl,	Pa.	★	★	★	★	—	—
	Bath (Tadmor Terminal),	Pa.	★	★	—	—	—	—
	Tamaqua (Arlington Terminal),	Pa.	★	★	—	—	—	—
Lehigh Valley	Buffalo,	N. Y.	★	★	—	—	—	—
	Coxton,	Pa.	★	★	—	—	—	—
	Jersey City,	N. J.	★	★	—	—	—	—
	Sayre,	Pa.	★	★	★	—	★	—
Long Island	Richmond Hill,	N. Y.	★	★	★	—	—	★
Louisville & Nashville	Boyles	Ala.	★	★	—	—	—	—
	Louisville,	Ky.	★	★	★	★	★	—
	Lexington,	Ky.	★	★	—	—	—	—
	Memphis,	Tenn.	★	★	—	—	—	—
	Mobile,	Ala.	★	★	—	—	—	—
	Montgomery,	Ala.	★	★	—	—	—	—
	Nashville,	Tenn.	★	★	—	—	—	—
	New Orleans,	La.	★	★	—	—	—	—
	Ravenna,	Ky.	★	★	—	—	—	—
Minneapolis & St. Louis	Minneapolis,	Minn.	★	★	★	★	—	—
Minn. St. P. & S. St. M.	Minneapolis,	Minn.	★	★	★	★	—	—

Class of Work Performed in Diesel Locomotive Repair Shops—(Continued)

LOCATION OF SHOP			RUNNING REPAIRS		HEAVY REPAIRS			
					Mechanical		Electrical	
Railroad	City	State	Mech.	Elec.	Engine Overhaul	Wheel Work	Excluding Armature Winding	Including Armature Winding
Missouri-Kansas-Texas	Parsons,	Kan.	★	★	★	★	★	—
	Waco,	Texas	★	★	★	★	★	—
Missouri Pacific	Dupo,	Ill.	★	★	—	★	—	—
	Little Rock,	Ark.	★	★	★	★	—	—
	Osawatomie,	Kan.	★	★	★	★	—	—
	St. Louis,	Mo.	★	★	★	★	—	—
	Sedalia,	Mo.	—	—	★	★	★	—
Nashville, Chatt. & St. Louis	Nashville,	Tenn.	★	★	—	—	—	—
N. Y., N. H. & H.	Boston,	Mass.	★	★	★	—	—	—
	Readville,	Mass.	—	—	★	★	★	—
	Danbury,	Conn.	★	★	—	—	—	—
	East Hartford,	Conn.	★	★	—	★	—	—
	New Haven,	Conn.	★	★	★	★	—	—
	New York (Van Nest Shop),	N. Y.	—	—	—	—	—	★
New York Central	Collinwood,	Ohio	★	★	★	★	★	—
	Harmon,	N. Y.	★	★	★	★	—	★
	New York City (72nd St.),	N. Y.	★	★	—	—	—	—
	West Springfield (B & A),	Mass.	★	★	★	★	—	—
New York, Chicago & St. Louis	Buffalo,	N. Y.	★	★	★	—	—	—
	Chicago,	Ill.	★	★	★	—	—	—
	Cleveland,	Ohio	★	★	★	—	—	—
	Conneaut,	Ohio	★	★	★	★	—	—
	Fort Wayne,	Ind.	★	★	★	—	—	—
	Madison,	Ill.	★	★	★	—	—	—
	Muncie,	Ind.	★	★	★	—	—	—
	Toledo,	Ohio	★	★	★	—	—	—
New York, Ontario & Western	Middletown,	N. Y.	★	★	—	★	★	—
	Norwich Shops,	N. Y.	★	★	—	—	—	—
N. Y. Susquehanna & Western	Ridgefield Park,	N. J.	★	★	★	—	★	—
Norfolk Southern	Charlotte,	N. C.	★	★	—	—	—	—
	Norfolk, Carolina Jct.,	Va.	★	★	★	★	★	—
	Raleigh,	N. C.	★	—	—	—	—	—
Northern Pacific	Auburn,	Wash.	★	★	★	★	—	—
	Brainerd,	Minn.	★	★	★	★	—	—
	Dilworth,	Minn.	★	★	—	—	—	—
	Glendive,	Mont.	★	★	—	—	—	—
	Jamestown,	N. D.	★	★	—	—	—	—
	Laurel,	Mont.	★	★	—	—	—	—
	Livingston,	Mont.	★	★	★	★	—	—
	Mandan,	N. D.	★	★	—	—	—	—
	Missoula,	Mont.	★	★	—	—	—	—
	Northtown,	Minn.	★	★	—	—	—	—
	Parkwater,	Wash.	★	★	—	—	—	—
	Pasco,	Wash.	★	★	—	—	—	—
	St. Paul,	Minn.	★	★	★	—	—	—
	Seattle,	Wash.	★	★	—	—	—	—
	Staples,	Minn.	★	★	—	—	—	—
	South Tacoma,	Wash.	★	★	★	★	—	★
	Tacoma,	Wash.	★	★	—	—	—	—
Pennsylvania Railroad	Altoona,	Pa.	★	★	★	★	—	★
	Columbus,	Ohio	★	★	—	★	—	—
	Crestline,	Ohio	★	★	—	—	—	—
	Enola (Frt. Loco.),	Pa.	★	★	—	★	—	—
	Harrisburg (Pass. Loco.),	Pa.	★	★	—	★	—	—
	Renovo,	Pa.	—	—	★	★	—	—
Pittsburgh & Lake Erie	McKees Rocks,	Pa.	★	★	★	★	★	—
Pittsburgh & West Va.	Pittsburgh, Rook,	Pa.	★	★	★	★	★	—
Reading	Eng. Hse., Bridgeport,	Pa.	★	★	—	—	—	—
	(st) Philadelphia, (Erie Ave., Eng. Hse.)	Pa.	★	★	—	—	—	—
	(st) Newberry Jct.,	Pa.	★	★	—	—	—	—
	Reading Eng. Hse.,	Pa.	★	★	—	—	—	—
	Reading Loco. Shop,	Pa.	★	★	★	★	—	★
	Wayne Jct. Elec. Car Shop,	Pa.	★	★	★	—	—	★
Rich. Fred. & Potomac	Alexandria, (Potomac Yard)	Va.	★	★	—	★	★	—
	Richmond,	Va.	★	★	—	—	★	—

Class of Work Performed in Diesel Locomotive Repair Shops—(Continued)

LOCATION OF SHOP			RUNNING REPAIRS		HEAVY REPAIRS			
					Mechanical		Electrical	
Railroad	City	State	Mech.	Elec.	Engine Overhaul	Wheel Work	Excluding Armature Winding	Including Armature Winding
St. Louis-San Francisco	Kansas City,	Mo.	★	★	★	★	—	—
	Lindenwood,	Mo.	★	★	★	★	★	—
	Memphis (Yale Yards),	Tenn.	★	★	★	★	—	—
	Springfield,	Mo.	★	★	★	★	★	—
	West Tulsa,	Okla.	★	★	★	★	—	—
St. Louis Southwestern	East St. Louis,	Ill.	★	★	—	—	—	—
	Pine Bluff,	Ark.	★	★	—	—	—	—
Seaboard Air Line	Atlanta (Howells),	Ga.	★	★	★	—	—	—
	Jacksonville,	Fla.	★	★	★	—	—	★
	Miami,	Fla.	★	★	—	—	—	—
	Richmond,	Va.	★	★	—	—	—	—
Southern	Atlanta,	Ga.	★	★	★	★	—	★
	Birmingham,	Ala.	★	★	★	★	—	—
	Chattanooga,	Tenn.	★	★	★	★	—	—
	Danville,	Va.	★	★	—	—	—	—
	Knoxville,	Tenn.	★	★	★	★	—	—
	Ludlow,	Ky.	★	★	—	—	—	—
	Macon,	Ga.	★	★	—	—	—	—
	Memphis,	Tenn.	★	★	—	—	—	—
	Meridian,	Miss.	★	★	—	—	—	—
	New Orleans,	La.	★	★	—	—	—	—
	Spencer,	N. C.	★	★	★	★	—	—
Southern Pacific	Los Angeles, (Gen. Shops)	Calif.	—	—	★	★	★	—
	Los Angeles, (Taylor Eng. Hse.)	Calif.	★	★	—	★	—	—
	Ogden,	Utah	★	★	—	★	—	—
	Roseville,	Calif.	★	★	—	★	—	—
	Sacramento, (Gen. Shops)	Calif.	—	—	★	★	★	—
	West Oakland,	Calif.	★	★	—	—	—	—
Texas & New Orleans	Houston,	Texas	★	★	★	★	★	—
	San Antonio,	Texas	★	★	—	—	—	—
Spokane, Portland & Seattle	Portland,	Ore.	★	★	—	—	—	—
	Vancouver,	Wash.	★	★	★	★	★	—
Term. R. R. of St. L.	Lovejoy, (Brooklyn Shop)	Ill.	—	—	—	★	★	—
	St. Louis, (14th St. Shop)	Mo.	★	★	★	—	—	—
	St. Louis, (Breman Ave. Shop)	Mo.	★	★	★	—	—	—
Union Pacific	Cheyenne,	Wyo.	★	★	—	—	—	—
	Denver,	Colo.	★	★	—	—	—	—
	Huntington,	Oregon	★	★	—	—	—	—
	Green River,	Wyo.	★	★	—	—	—	—
	La Grande,	Oregon	★	★	—	—	—	—
	Las Vegas,	Nev.	★	★	—	—	—	—
	Los Angeles,	Calif.	★	★	★	—	★	—
	Miford,	Utah	★	★	—	—	—	—
	Ogden,	Utah	★	★	—	—	—	—
	Omaha,	Neb.	★	★	★	★	—	★
	Pocatello,	Idaho	★	★	★	—	—	—
	Portland Terminal,	Oregon	★	★	—	—	—	—
	Rieth,	Oregon	★	★	—	—	—	—
	Salt Lake,	Utah	★	★	—	—	—	—
Union Railroad	Hall,	Pa.	★	★	★	★	★	—
Wabash Railroad	Decatur,	Ill.	★	★	★	★	★	—
	Moberly,	Mo.	★	★	—	★	—	—
	St. Louis (Vandeventer),	Mo.	★	★	—	—	—	—
Western Maryland	Elkins,	W. Va.	★	★	—	★	—	—
	Hagerstown,	Md.	★	★	★	★	★	—
	Hanover,	Pa.	★	★	—	—	—	—
	Md. Jct.,	W. Va.	★	★	—	★	—	—
	Baltimore, Pt. Covington,	Md.	★	★	—	★	—	—
Western Pacific	Oakland,	Calif.	★	★	★	★	—	—
	Oroville,	Calif.	★	★	★	★	—	—
	Sacramento,	Calif.	—	—	—	★	—	—

EDITORIALS

Locomotive Conditions Improved

A marked improvement in the condition of motive power during the fiscal year ended June 30, 1949, as compared with those prevailing during the preceding year are shown in the annual report of Edward H. Davidson, director, Bureau of Locomotive Inspection. There were 105 fewer accidents caused by failures of locomotives or their appurtenances, 5 fewer persons killed and 101 fewer injured as the result of these accidents than were reported for the previous year. Considering steam locomotives alone, there were 113 less accidents, 5 less killed and 118 less injured. Boiler explosions were down to 5 from 14 in 1948, the deaths caused by them were reduced from 12 to 7 and the number of injured from 15 to 14.

This marked reduction in boiler explosions does not justify any relaxation in discipline with respect to the condition of boilers nor with respect to their management on the road. With the exception of one death caused by a handhold failure, the causes of the deaths of those killed during the 1949 fiscal year were either boiler explosions or failures of other parts directly associated with the steam boiler.

The improvement in the number of accidents caused by failures of steam locomotives or their appurtenances is only partially accounted for by the reduction in the number of locomotives for which reports were filed and the reduced locomotive mileage made by steam. The reduction in the number of accidents and killed and injured was about one-third from the previous year, while the number of locomotives reported and the number inspected were less than 10 per cent off from the figures for 1948. Combined freight and passenger locomotive road mileage made by steam declined 17½ per cent and steam switch-engine hours by 18½. Even on this basis of comparison a substantial improvement in steam-locomotive conditions is indicated.

Neither the number of accidents nor the casualties caused by failures of locomotives other than steam are large in number but the rate of increase was large. The increase in the number of accidents was 19 per cent and in the number of casualties, 34 per cent. The number of locomotives for which reports were filed increased 29 per cent and the number inspected, 45 per cent. The types of accidents most frequently recurring on these locomotives, a large proportion of which are Diesel-electrics, are fires from various causes, and short circuits. Others, however, recur frequently enough to be worthy of attention: engine-room floors wet with oil or water, cab seats which fall apart with men in them, doors which cannot be fastened open and are slammed shut by the motion of the locomotive, and defective steps and footboards. Failures like these and of other items unassociated with the effectiveness of the functioning of the mechanical and electrical equipment of the locomotive are likely to become increasingly noticeable whenever maintenance standards begin to slip.

The proportion of locomotives inspected and found defective during the past year is the lowest during the past six years. The percentage for steam locomotives dropped from 10 in 1948 to 8 last year. A slight decline from 4.1 to 4 per cent is recorded for locomotives other than steam. A high standard of locomotive conditions has been attained during the past year. To maintain it consistently year after year will not be easy.

The report will be the subject of a more complete review in an early issue.

Present and in Prospect

Two sharply contrasting articles on closely allied subjects appear in the Electrical Section of this issue. One of them describes the control system for a gas-turbine-electric locomotive and the other deals with traction-motor and generator maintenance. The former describes equipment designed specifically by one manufacturer for use on a new type of locomotive now being tried out by a railroad. The other offers general recommendations on current practice of motor and generator operation and maintenance.

To the uninitiated, it might appear that the gas-turbine locomotive control is just a bunch of gadgetry which would be of interest only after the locomotive had proven itself, and the controls had gone through a series of changes to arrive at some nearly permanent state. Under such circumstances, the article would be of little more than academic interest. Actually, the controls are essentially similar to those used on Diesel-electric locomotives, but they differ in that they must conform to some fundamentally different power-plant characteristics.

The motor and generator maintenance article is concerned with the desirability of having a traction motor that will go from shopping to shopping with a minimum of attention and a generator that will also fit into a maintenance schedule. It deals with brushes, with bearings and lubrication, with the determination of tonnage ratings, with the establishment of mileage between overhauls, with rewinding and the question of keeping dirt out of electrical machines.

Present indications are that the gas-turbine-electric locomotive will find a place in the railroad field. This makes it of interest to management to learn of its economic advantages. The operating department needs to learn how it may fit the requirements of a specific railroad. Mechanical and electrical engineers must work with designers to keep the equipment as similar as practicable to that being used on Diesel-electric locomotives. There is a chance that on these locomotives pinion and gear spacing may be standardized. The purchasing and stores departments are also interested in learning how great a variety of parts may have to be carried in stock. The shop men will want to know if these locomotives can be fitted into present Diesel maintenance schedules and what if any change in shop tools will be required. The maintainers will have a number of new things to learn.

All this is looking into the future. The manufacturers themselves do not feel that the locomotives have reached a state of development justifying their sale. But many future headaches may be avoided by cooperative planning on the part of the builders and the railroads. From the railroads the needed information will come from the top and the bottom and from all departments. Almost anyone on a railroad may be called upon to supply needed information, and the two articles referred to are offered to those who wish to keep abreast of this situation. More will follow.

Times Do Change!

The changes that have taken place in the railroad industry in the past few years have been revolutionary in nature and the extent to which they have affected the industry is just beginning to show up in some of the statistics as they become available. With respect to operating expenses, the details appear in the Interstate Commerce Commission reports as much as two years late so that a study of the figures is in the nature of a post-mortem, regardless of which fact they are decidedly interesting. The latest available statistics, in detail, are for the year 1947 and a study of the statistics for the past five years, for example, reveals what has been taking place in some of the accounts that are of major interest to mechanical department officers and supervisors.

MAJOR OPERATING EXPENSE ACCOUNTS—MILLIONS

	1948	1947	1946	1945	1944
Steam locomotive repairs	519.0	527.0	522.0	530.0	547.0
Other locomotive repairs	110.6	76.7	54.2	45.8	37.3
Train fuel	643.8	545.0	452.0	462.0	473.0
Repairs to shop machinery	35.0	31.6	30.1	31.3	30.5
No. of steam locomotives	29,270	37,573	37,575	38,948	39,309
No. of Diesel-electric units	7,326	4,451	3,304	2,833	2,205

It will be seen that it was only a little over three years ago, in the year 1946, that the largest single item of operating expense was Account 308—Repairs to Steam Locomotives. In that year this account, for road and yard power, required an expenditure of 522 million dollars for maintenance and this figure was not exceeded by any other operating expense account. As a matter of record, in 1947 and in 1948, steam locomotive repairs ceased to be the largest single expenditure and, for the first time in many years, the fuel bill took top place in the list of items for which the Class I roads spend their money.

One of the significant things which these figures show is the fact that while the inventory of steam locomotives dropped from 39,309 in the year 1944 to 29,270 in 1948, and the number of Diesel-electric units increased from 2,205 to 7,326 in the years mentioned, the total cost of steam locomotive repairs changed only from a high of 547 million dollars in 1944 to 519 million dollars in the year 1949. During the same period the cost of repairing "other locomotives," which account includes the Diesel-electric power, increased from 37.3 million dollars to 110.6 million dollars, so that the total cost of maintaining motive power increased from 584 million dollars to 630 million dollars in the five-year period.

Also in spite of the great numbers of steam locomotives that have been retired and the increase in the number of Diesel-electric units installed the total fuel bill of the Class I roads has increased—for train fuel alone for example—from 545 million dollars to 643 million dollars, an increase of almost 100 million.

It has been pointed out any number of times in these columns that the steam locomotive still represents almost 80 per cent of the motive power inventory of the Class I railroads and the year 1949 indicated beyond a doubt that most of the railroad mechanical people have more or less "walked off and forgotten" the problem of maintaining this power.

The suggestion is made now—even a prediction, if you care to gamble—that this short-sighted policy on the part of practically all roads with respect to the facilities in back shops and engine terminals is going to lead to maintenance costs in the remaining years of the life of steam motive power that will be unjustifiably high. In 1949, for example, expenditures for the modernization of shop and terminal facilities used in connection with the maintenance of steam power probably hit a low unequalled except for depression years and the expenditures for Diesel-electric repair shops and running-repair terminals set a new record.

Strangely enough, the remaining equipment in shops and terminals is becoming more obsolete all the time and the roads, not having a well established policy with respect to shop programs, keep on spending millions for the "maintenance" of this obsolete shop equipment to the tune of 30.5 million dollars in 1944 and 35 million dollars in 1948. Even a third of

this expenditure allocated to the purchase of modern machine tool and shop equipment would save thousands of man hours annually and the new facilities could easily pay for themselves many years "before the last steam locomotive leaves the rails"—if such an event ever takes place.

NEW BOOKS

LATHE OPERATORS' HAND BOOK. *128 pages illustrated, published by the South Bend Lathe Works, South Bend 22, Ind. Price $.25 paper binding, $1.00 leather fabrikoid binding.*

Revised edition 49 of this book describes the care and operation of metal-working lathes and was written to be used as a reference by experienced machinists or as a text by the apprentice or shop student. Eleven chapters cover various types of work including the correct installation and leveling of the lathe, grinding cutter bits, turning, boring, thread cutting, taper turning, drilling, reaming and tapping.

The first edition of this book was copyrighted in 1914. Each succeeding edition has been revised and improved to include suggestions and ideas that have been submitted by practical shop men. New material added in the latest edition includes machinability ratings and cutting speeds for various kinds of steels; standard tolerances for press fits, running fits, push fits and sliding fits; allowances for finish turning, filing, polishing, grinding, reaming, lapping and honing; and tooling dimensions for South Bend Lathes.

WELDING AND CUTTING MANUAL. *208 pages, illustrated. Published by the Linde Air Products Company, a unit of Union Carbide and Carbon Corp., New York. Price $1.80.*

This hand book on the oxyacetylene process is intended as a reference and instruction book for those concerned with oxyacetylene welding and cutting, and presents hints and short-cuts which will help them do a better job. It contains chapters on bronze-welding; fusion welding; soldering; hard facing; cutting steel and cast iron; heating, forming, and straightening metals; welding and cutting pipe; and welding non-ferrous metals, including aluminum, copper and lead.

The book opens with a general description of the oxyacetylene process, and distinguishes between welding, brazing and cutting operations. Illustrated descriptions of fundamental welding jobs follow, e.g., heating and bending, straightening, pipe bending, and removing rusted fittings. Fundamentals of flame-hardening and hardening and tempering are explained.

The book continues with a chapter devoted to soldering and brazing with an air-acetylene flame. Five points for good soldering are listed, and a brief description of how to use the equipment follows. In this chapter explanations are given on how to do various soldering jobs such as repairing a small hole, soldering a seam and various electrical jobs. Lists of commonly used solders and fluxes are included, along with the type of metal and work for which they are suitable. Similar hints on good brazing are described, and a table is included which explains various temperature characteristics of different silver-brazing alloys and lists the metals to which each is applicable.

Additional chapters give details on more complex phases of such work as cutting cast iron and steel, repairing and building with welding, hard-facing of wearing parts, points to remember in welding most common metals, and how to make 100 representative things by welding, varying from hat racks to machinery guards. The final chapter describes the setup and operation of the equipment, its care and use, and how to test for the causes of trouble in the equipment.

The appendix lists 16 tables, among which are identification of metals by appearance, by chip test, by flame test, and by spark test; recommended welding methods for various non-ferrous metals, and the flame adjustment, rod and flux recommended; characteristics of rods for welding ferrous and non-ferrous metals; welding flux data; and hard-facing rods.

WHO'S WHO IN RAILROADING (*Twelfth Edition*). *827 pages, 8¾ in. by 5¾ in. Bound in cloth. Compiled and published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York 7. Price, $10.00.*

The past few years have been marked by an exceptionally large number of changes in the ranks of American railroad officers, reflecting adjustments sometimes postponed and sometimes accelerated by the abnormal conditions resulting from the war. These many changes have required revision of this standard reference work, so that up-to-date biographical data may continue to be available about the important people connected with the railroad industry. In its present twelfth edition, promotions, transfers and retirements effective since the eleventh edition was printed in 1946 have required more or less major modifications of nearly every sketch which appeared in the preceding edition, while the rise of newcomers to the top ranks of railroad personnel has required inclusion of sketches of about 2,000 individuals not previously listed. Special attention has been given to war service records of those railroad men who served with the armed forces.

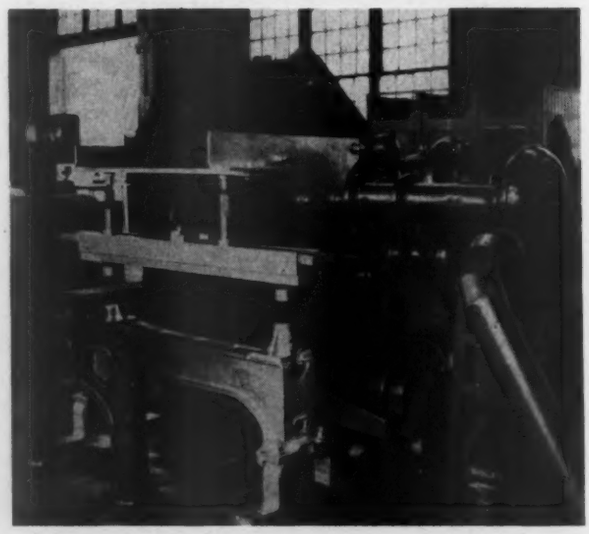
The present edition includes some 6,100 individual biographies, a net increase of about 400 as compared with the 1946 volume. Ranging from Henry A. Aalberg, assistant chief engineer of the Chicago, Burlington & Quincy, to Judson Zimmer, president of the Fonda, Johnstown & Gloversville, the 6,100 sketches include not only railroad officers, but also leaders of the railway supply industry and of railway labor, regulatory authorities, transportation economists and railway financial analysts, educators concerned with transportation problems, I. C. C. practitioners and a selected group of consultants, authors and editors.

SHOPS AND TERMINALS

Tooling for Reclamation*

DIESEL-electric locomotive parts reclamation is in its infancy and at this time few railroads are attempting the manufacture of any great number of parts. We believe most railroad officers are striving to work out methods and develop procedures which will enable them to perform a much larger part of the Diesel locomotive parts reclamation and manufacture in their own shops, utilizing to the greatest extent possible existing machine tools and manpower.

With this idea in mind the committee has attempted to choose for presentation Diesel locomotive parts which are being reclaimed on machine tool equipment commonly found in steam locomotive repair shops.



Opposite sides of Micro grinder set up for traction-motor frame suspension bearing supports—The slide arrangement is shown above; actual grinding operation below

Diesel A-Frames

Reclaiming Electro-Motive Diesel engine frames when difficulty is experienced by the distortion of the main bearing A-frame or bearing supports caused by overheated bearings can be accomplished by utilizing either a large horizontal boring mill or a Norton cylinder machine.

The procedure is to remove the studs from the A-frame at the bearing supports requiring reworking. The crankcase is set up on the machine and the serrations are re-cut with a pair of milling cutters mounted on an arbor and carefully spaced to match the existing serrations on the A-frame. Only enough metal is removed to clean up all the surfaces on these serrations. The cap for that particular location is milled without disturbing the spacing of the cutter as it is important that the serrations match perfectly. This must be carefully checked. A satisfactory method is to check the dimension across the joint as the cap studs are tightened. After all distorted bearing supports have been machined and the caps applied, the crankcase can be line-bored on this same machine, care being taken to position the bar so that no metal is removed at the top of original bore as this would affect the gear mesh.

This method of reclamation has proved satisfactory on the D. & R. G. W. and a substantial saving in time and expense can be realized by handling this job in the shop.

Traction Motor Frame Suspension Bearing Supports

In cases of overheated suspension bearings, it has been found that when distortion of the bearing support takes place the cap, in most cases, closes in considerably more than the frame portion. This causes reduced clearance between the axle and bearing and also permits some misalignment.

This step fit on the cap is built up by electric weld

* A portion of the report of the Committee on Shop Tools presented at the annual meeting of the Locomotive Maintenance Officers' Association at Chicago in September, 1949. The report described in detail devices and the methods of their use in machining or reclaiming a variety of parts for steam and Diesel-electric locomotives. Some of the shop tools for handling Diesel-electric and steam locomotive parts are included here and others will be described in subsequent issues.

and the cap is machined to fit the mating surface, enough material being removed to permit boring to original dimensions. Bearing supports are then line-bored to size, care being taken to have the boring bar parallel to the motor armature shaft and correctly positioned to insure proper gear meshing. Here again no metal should be removed from the original bore at the point adjacent to the armature shaft bearings.

A horizontal boring mill is usually used for the line boring operation although the Chicago & Eastern Illinois is doing this work on a Micro grinder.

A special fixture is used with this machine to carry part of the weight of the traction motor. This fixture consists of a slide arrangement mounted on rollers to permit smooth and free movement.

Cylinder Liners

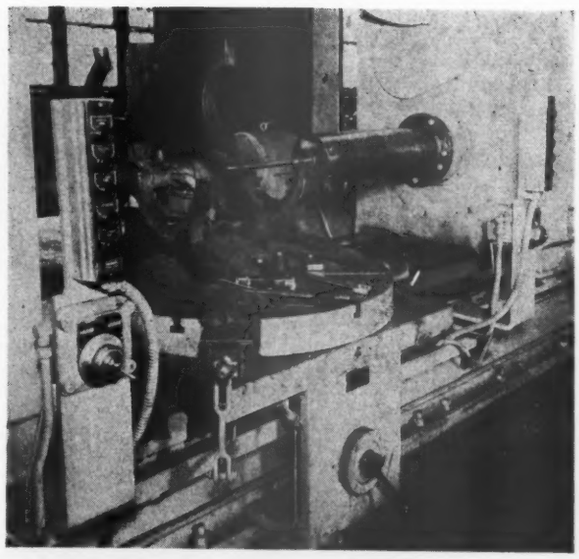
The reclamation of Diesel engine cylinder liners is being carried on by a number of roads with good results. A considerable saving is to be realized both in cost per liner and also by reduction in stores inventory. Alco road locomotive liners can be reclaimed by renewing the chrome plating. Experiments indicate that liners replated with hard chrome will actually give better service than those originally obtained from the engine manufacturer. Liners are plated and then ground to size which produces liners having accurate dimensions and good finish. Electro-Motive engine cylinder liners can be reclaimed by chrome plating. These liners can be rebored to oversize in the shop on a Micro grinder or on a boring mill equipped with a special bar having a spring-loaded tool which is cam actuated for generating the "Mae West" at the port location. This boring bar has a rod extending through the center of the boring head and this rod has the "Mae West" profile on the body. As the rod is depressed, the profile passes under the spring-loaded tool, thus forcing the tool into the liner during this portion of the bar travel. The Chicago & North Western is using this type bar for reboring liners.

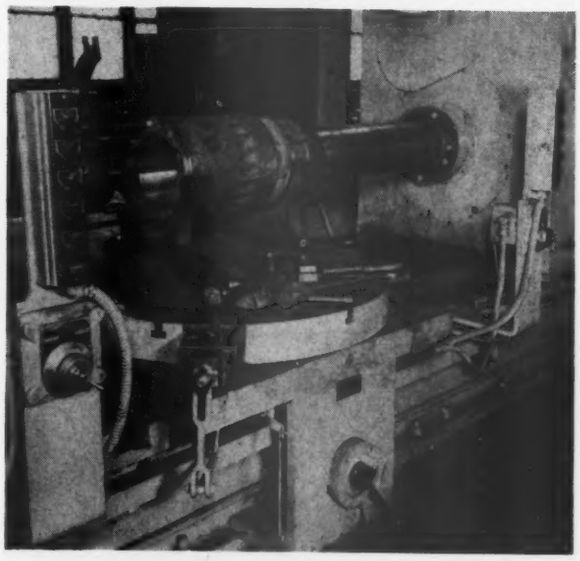
After the boring or grinding operation on these liners it is the practice to hone or lap the bores to produce a super finish. This work is performed either on a separate machine designed for this purpose or by the use of a portable honing tool. This operation can be performed directly on the boring mill and saves the additional handling of the liner.

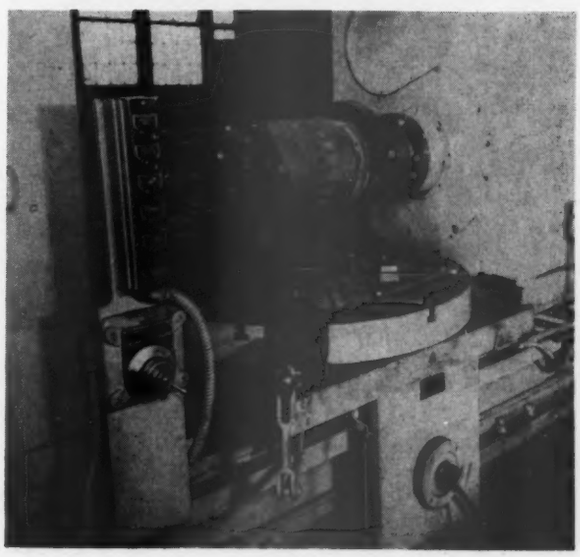
The New York Central is making use of a honing tool on a horizontal boring mill. One illustration shows this honing tool finishing an Electro-Motive engine liner.

The New York Central also has an ingenious device for removing the shoulder at the top of Diesel engine cylinder liners. This tool can be used without removing the liner from the engine. Liners which have been removed for this cause can have shoulders removed with this same tool right on the shop floor.

This tool consists of an air-powered grinder with centering device and feed arrangement to permit both horizontal and vertical movement of grinding wheel. The grinder is mounted on an arm which permits ro-

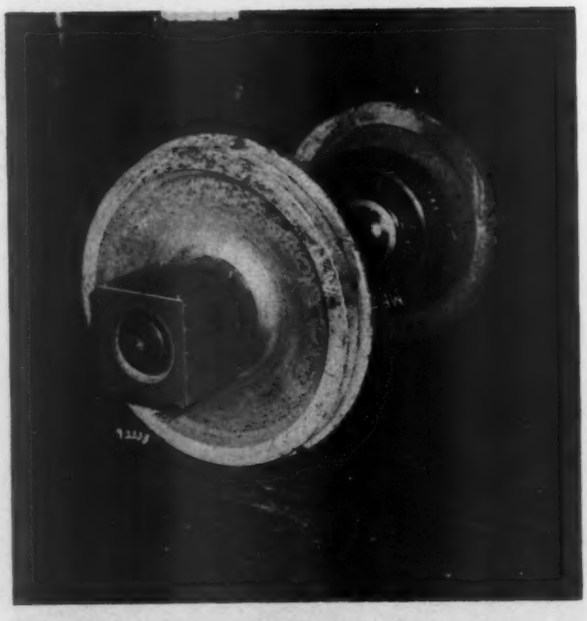






Fixtures set-up and operation of reboring cylinder liners for Electro-Motive Diesel engines on a horizontal boring mill

Air-powered portable tool for removing the shoulder from Diesel-engine cylinder liners



Induction heater for removal and application of inner races of journal bearings—Time, 25 sec.

tation in the cylinder around the centering device. This tool saves time in the actual machining or grinding operation, plus the savings in handling the liner in and out of engine and on to machine. No expensive critical machine tools are tied up in doing this work.

Wheels and Axles

The wheel and axle work required to maintain a fleet of Diesel locomotives in service is considerable and deserves consideration as to the type equipment required and where best to handle this work.

Experience indicates that this wheel work can be performed in the wheel shop along with the other steel wheel work, car wheels and the wheels for steam locomotive truck, trailer and tanks. Absorbing this additional wheel work in the wheel shop proved practical and showed a large saving as it simply meant the greater utilization of the existing wheel shop equipment and necessitated the addition of only two machines with some minor additions to handling facilities. These new facilities permit the handling of wheels with a traction motor into a wheel lathe for tread turning without removing them from the motor.

The new machines were a 42-in. Bullard Vertical Turret Lathe and a wheel press. This press was a conventional car wheel press which with some alterations and the addition of a special resistance member to permit pressing off the wheels without disturbing the axle gear. Press was installed in a vertical position which placed the upper tension member back of the vertical center line and permits handling the wheel and axle assemblies into press with overhead hoists.

Wheel tread turning is handled on a car wheel lathe and the treads may be ground after turning.

Removing Bearing Races

A special induction heater is used to remove and apply journal bearing inner races. Heading time with this heater is only 25 seconds and heating is uniform for the entire length and circumference of the bearing race. One of the photographs illustrates this heating device in place for removal of an inner race and another shows a pneumatic tired carriage used to transport the wheel and traction motor assemblies from Diesel shop to the wheel shop. Carriage will accom-

Power wrench with torque wrench for accurate and correct tightening of nuts—The bracket, with short footboard, permits working on upper engine deck

modate two pairs of mounted wheels or a traction motor wheel assembly.

The Central of Georgia Railway is maintaining a fleet of Diesel locomotives on a progressive maintenance schedule set up on a mileage basis. Accurate and complete records are kept for each locomotive.

Routine reclamation work on that road consists of (1) reboring cylinder liners and honing for good finish; (2) armature shafts, fan shafts and other similar parts are restored by metal spraying and remachining to original dimensions; (3) valves are reclaimed by building up with Stellite No. 12 rod and grinding; (4) traction motor suspension bearings are restored by counter-boring the bearing at the inside ends for the clearance. These bearings can also be reclaimed when the face has become worn to the extent of excessive lateral. The method is to rivet a steel plate to the back of the collar and the face of the bearing is then machined to bring the collar thickness and lateral back to standard.

Special Hand Tools

Special hand tools such as torque and power wrenches are a necessity in the proper maintenance of Diesel engines. With special tools such as these it has been found that relatively unskilled men are able to turn out satisfactory workmanship on this equipment.

Committee Members

The members of the committee preparing this report were C. R. Eisele (chairman), master mechanic, Denver & Rio Grande Western; W. H. Haynes, (vice chairman), master mechanic, Chicago & Eastern Illinois; E. H. Holloway, general Diesel supervisor, Central of Georgia; W. D. Nelson, superintendent locomotive shops, Louisville & Nashville; C. N. Rector, production engineer, Chicago & North Western; E. J. Kelly, supervisor of tools, Atchison, Topeka & Santa Fe; John A. Warren, Apex Machine Tool Co.; W. P. Sullivan, supervisor Diesel equipment, Missouri Pacific; J. I. Stewart, chairman, Machine and Tool Committee, New York Central System; W. A. Hotzfield, assistant to mechanical superintendent, Diesel and Electric Power, Chicago, Milwaukee, St. Paul & Pacific; Frank Hoffelt, Diesel foreman, St. Louis-San Francisco, and J. L. Robson, superintendent motive power and Diesel equipment, Great Northern.

Questions and Answers

The question and answer department is included for the benefit of those who may desire assistance on problems involving matters pertaining to the operation or maintenance of air brakes, Diesel-electric locomotives, steam locomotive boilers or steam locomotive practice. Any inquiry should bear the name and address of the writer, whose identity will not be disclosed unless special permission is given to do so. Anonymous communications will not be considered. Inquiries addressed to this publication will be referred to the source from which an authoritative answer can be secured.

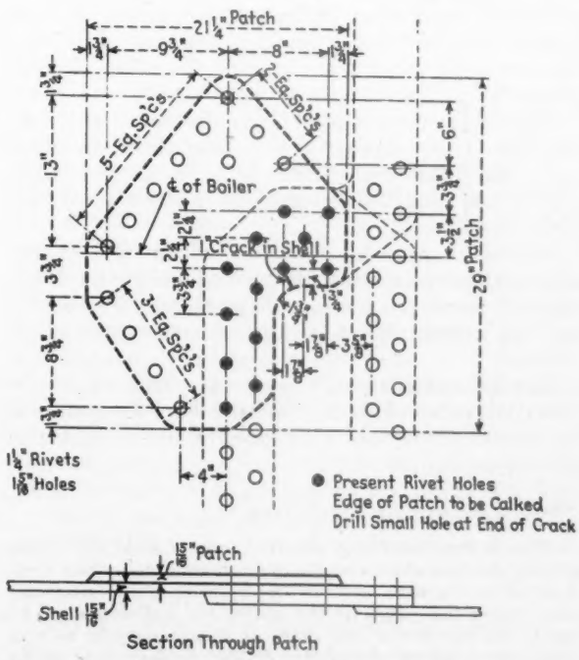
Steam Locomotive Boilers

By George M. Davies

Patch for Cracked Shell Plate

Q.—Please illustrate a typical patch for reinforcing a crack in the shell plate at the connection with the top of the throat sheet, the crack extending out of the corner of the plate where the shell is cut away for the throat sheet connection.—R.E.V.

A.—The accompanying drawing illustrates a typical boiler patch for reinforcing a crack in the shell extending out of the corner of the shell plate where same is cut away for the throat sheet connection. The shell plate is reinforced by applying a diamond-shaped patch using the original throat seam rivets and extending the patch into the shell course to provide the necessary reinforcement.



The above illustration appeared incorrectly in the January issue

Efficiency of Shell Seams

Q.—What efficiency is permitted for the longitudinal seam of a welded locomotive boiler shell?—F.E.D.

A.—The joint efficiency of a welded longitudinal seam of a locomotive boiler shell is taken as 90 per cent of the lowest tensile strength of the plate, when determining the maximum allowable working pressure based on the strength of the weakest course, computed from the thickness of the plate, the tensile strength stamped thereon, the efficiency of the longitudinal joint, the inside diameter of the course, and the factor of safety, provided that the fusion welding is in accordance with the requirements for material, design, test and stress relieving as provided in the A.S.M.E. Code for Boilers of Locomotives.

Tolerances For Reaming Holes

Q.—When laying out and drilling holes in the flat plates of boiler sheets, longitudinal seams and firebox plates, what tolerances are used to allow for reaming out the holes after the sheets are rolled and assembled?—E. C. R.

A.—In order to have rivet holes true when the plates are assembled, the actual diameter required to receive the rivet is obtained by reaming or redrilling the holes after the parts are assembled. The drilled diameters or rivet holes which have been found to assure true holes when reamed or redrilled are as follows:

Drilled holes in longitudinal seams and welt strips equal diameter or rivet before driving minus $\frac{5}{16}$ in. All circumferential seams (except roof to ring and ring to throat) under steam pressure equal diameter of rivet minus $\frac{1}{8}$ in. Roof to ring and backhead, ring to throat, and front tube sheet equal diameter of rivet minus $\frac{3}{16}$ in. Rivet holes in rings for angles and liners equal diameter of rivet minus $\frac{1}{8}$ in. All brace feet, supports, and roof sheet liners holes equal diameter of rivet before driving.

Crown sheet rivet holes, equal diameter of rivet minus $\frac{1}{16}$ in. Roof, backhead, throat sheet, and firebox ring rivet holes equal diameter of rivet minus $\frac{1}{8}$ in.

Where the rivet hole drilling allowance is $\frac{3}{16}$ in. smaller (except crown sheet) than the rivet diameter, the plate connection is to a flanged plate, which has punched rivet holes instead of drilled holes.

Having more metal to cut on account of a greater minus allowance, below the rivet diameter for longitudinal seam rivet holes, these holes are redrilled to the correct rivet-driving diameter instead of reamed.

Smokebox circumferential seam; punch rivet holes equal diameter of rivet before driving. Longitudinal seam and front ring rivet holes equal diameter of rivet plus $\frac{1}{16}$ in.

Seal Welding in Fireboxes

Q.—It has been our practice to seal weld the edges of the firebox sheets at the corners of the firebox ring, extending the weld around the corners of the ring and also along the edges of the plates for a distance of 12 to 15 inches above the ring. Is it permissible to seal weld the edge of the sheets to the firebox ring along the sides, front and back, where difficulty is experienced in caulking the sheets to the ring?—M.I.V.

A.—The rivets in the firebox ring should not be spaced in excess of good caulking practice making it necessary to resort to seal welding to obtain a tight joint.

The A.S.M.E. Code for locomotive boilers permits welding of the firebox ring as follows:—"Any crevices between the mud ring and the sheets of a locomotive boiler may be made tight by seal welding when the mud ring is secured by riveting."

Steam Locomotive Practice
By George M. Davies

Capacity of Bearing

Q.—In considering capacities of roller bearing versus friction bearing tender truck boxes, are roller bearing journals permitted to carry a greater load than the friction bearing journal of the same size? —E.D.V.

A.—The A.A.R. Manual of Standard and Recommended Practices gives the following load rating for passenger car axles, based on journal size, irrespective of whether friction or roller bearing truck boxes are used.

A.A.R. axle designation	Size of Journal (in.)	Capacity for axles for normal maximum operating speeds of approximately	
		Up to and including 85 m.p.h. (lb.)	86 to 100 m.p.h. (lb.)
A	3¾ by 7	12,500	12,000
B	4¼ by 8	20,500	19,000
C	5 by 9	27,000	25,500
D	5½ by 10	34,000	32,000
E	6 by 11	42,500	40,000
F	6½ by 12	51,000	48,000

Working Load of Locomotive Springs

Q.—In computing locomotive springs, how is the working load of the spring obtained?—R.K.V.

A.—The working load of the spring is the static load (load on wheels at rails after the actual weight of the parts constituting dead load, such as wheels, axles, boxes, etc. has been deducted.)

The general practices for:

(a) *Driving springs.* Use calculated static load plus 500 to 1,000 lb., or about five per cent.

(b) *Engine truck springs.* Elliptic—Use calculated static load plus 10 to 20 per cent as follows:

38-in. length centers and under 10 per cent

40-in. to 48-in. length centers and under 15 per cent

50-in. length centers and over 20 per cent

Total deflection on four-wheel trucks should not be less than that of the driving springs on the same engine, when transverse centers of truck and driving springs are equal or approximately equal.

Helical—Use calculated static load plus 5 per cent to 15 per cent, preferably 15 per cent.

(c) *Underhung driving springs.* For passenger engines, use calculated static load plus 20 per cent.

(d) *Trailing springs.* Elliptic—Use calculated static load plus 10 to 20 per cent.

Helical: Use calculated static load plus 15 to 20 per cent.

(e) *Tender springs.* Use calculated static load taken with maximum load of coal and water.

Types of Screw Threads

Q.—Much importance is being placed on the class of thread fit to be used on the various nuts and bolts on the locomotive. Please explain where the various classes of fits are intended to be used.—M.F.R.

A.—The National Screw Thread Commission, and the American Institute of Bolt, Nut and Rivet Manufacturers make the following recommendations in connection with the use of the three classes of thread fits as follows:

Class 1—The Class 1 fit is recommended only for screw thread work where clearance between mating parts is essential for rapid assembly and where shake or play is not objectionable.

Class 2—The Class 2 represents a high quality of commercial screw thread product and is recommended for the bulk of interchangeable screw thread work.

Class 3—Class 3 represents an exceptionally high grade of threaded product and is recommended only in cases where the high cost of precision tools and continual checking of tools and product is warranted.

Self-Cleaning Ash Pans

Q.—Do the I. C. C. rules require that the ash pans be self-cleaning, in that when the hopper doors are opened all ashes contained in the pan will fall to the ground?—M.I.D.

A.—The I. C. C. Bureau of Locomotive Inspection, Laws, Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders provide that:

(a) Ash pans shall be securely supported and maintained in safe and suitable condition for service.

(b) Locomotives built after January 1, 1916, shall have ashpans supported from mud rings or frames. Locomotives built prior to that date which do not have ash pans supported from mud rings or frames shall be changed when locomotive receives new firebox.

(c) The operating mechanism of all ash pans shall be so arranged that it may be safely operated and maintained in safe and suitable condition for service.

(d) No part of ash pan shall be less than 2½ in. above the rail.

There are no provisions in the rules requiring that the ash pans be self-cleaning, although wherever possible a self-cleaning ash pan is desirable. On modern locomotives with wide fireboxes and four-wheel trailing trucks it is difficult to obtain sufficient slope to the ash pan side sheets to have the ash pan self-cleaning, particularly where pockets are required over the trailing truck wheels, under these conditions ash pan flushers are applied to clean off the slope sheets after the hoppers have been opened.

Schedule 24RL Air Brakes

Independent Brake Valve Operation—Application

878-Q.—How is the independent application obtained? A.—By moving the brake valve handle to the right. The further the movement the greater the pressure obtained in the brake cylinders.

879-Q.—What takes place when the brake valve handle is moved toward the right? A.—The cam on shaft *11* moves pusher *68* and attached lever *67*, the ends of which are positioned on the inlet and exhaust valves. Spring pressure plus air pressure, acting to hold the exhaust valve closed, is stronger than the spring pressure holding the exhaust valve open; therefore, the first movement of the cam to move the floating lever causes the exhaust valve to close, cutting off brake valve exhaust to the atmosphere, *At.*

880-Q.—What results from further movement of the brake valve handle? A.—Further movement to the right causes additional movement of the lever, which now fulcrums on the exhaust valve and opens the inlet valve.

881-Q.—With the inlet valve open, what action takes place? A.—Main reservoir pressure from passage *30* flows into chamber *B* of the brake valve, past unseated inlet valve to passages *20* and *44* to the Rotair valve. The Rotair valve rotary connects passage *44* to the application and release pipe *20*, and to the *D-24* control valve.

882-Q.—What takes place at the control valve? A.—The air flows through passage *20* to the lower face of check valve *252c*. The check valve is moved upward to seat upper check valve *252b*.

883-Q.—What does seating the check valve* 252b *accomplish? A.—The displacement reservoir and automatic application passage *36* are sealed off

884-Q.—What does unseating lower check valve* 252c *accomplish? A.—Passage *16* is uncovered, allowing the flow of air to the relay valve to develop brake cylinder pressure.

Independent Brake Release

885-Q.—What takes place as the brake valve handle is moved toward release position? A.—The cam on the shaft moves away from the floating lever stem of the self-lapping unit.

886-Q.—What happens then. A.—The lever then pivots on the closed inlet valve, and the exhaust valve spring moves the exhaust valve away from its seat, allowing application and release pipe air to flow through the brake valve to atmosphere "At".

887-Q.—What takes place if the brake valve handle is moved only part way toward release position? A.—Application and release pipe air in brake valve chamber *B* and acting on the piston type exhaust valve seat, will be partially reduced.

888-Q.—What action then takes place? A.—The regulating spring will move the seat into contact with the exhaust valve and prevent further flow of air from the application and release pipe.

889-Q.—With the brake valve handle in release position, what takes place? A.—The cam on the handle shaft is moved away from the floating lever and the exhaust valve spring holds its valve open to vent all air pressure from the application and release pipe.

890-Q.—Describe the operation at the D-24 Control Valve. A.—The flow of application and release air in independent release is the reverse of that in independent application.

891-Q.—What takes place at the relay valve? A.—With the independent brake valve handle returned to release position, the air is exhausted from the relay valve, giving a complete release of brake cylinder air.

CAR INSPECTION AND REPAIR

Testing Brakes on Long Trains*

By G. E. Carothers†

With the introduction of the AB brake it became possible to control and handle longer trains until today trains of 150 cars are common. With these long trains, it is essential that they be properly tested, made up, and handled in the yards. The majority of air brake road failures are caused by stuck brakes and undesired emergencies. It has been found that careless, insufficient or improper assembly and testing of trains at terminals or inspection points is the primary cause of these undesired emergencies and stuck brakes on trains enroute.

Let us consider first the matter of train make-up. With the long trains that are being hauled today, many yards are not long enough to permit assembling the trains on one track and yard-testing it as a single unit. A typical condition is to make up the train in three sections of 50 cars or less and test these sections separately. The road locomotive is then coupled to one section, doubles over onto the second section and the rear end is put on with a drill engine. The most serious condition that arises when this method is used is the possibility of overcharging the rear section of the train. I have often been asked how the rear of a train can be overcharged if the switcher carries the same pressure as the road locomotive, and a full service reduction is made.

The accompanying table shows the gradient when the locomotive is in control. If cars are switched on the rear end, the last car is charged to same pressure as the first car. Even though a full service reduction is made by the engineman for a road test, the emergency reservoir on the last car of a 150 car train is reduced only 4 lb. and a 100 car train about 5 lb. To take an extreme example—80 lb. brake pipe pressure 150 cars, 7 lb. uniform leakage, last 20 cars switched on at 80 lb. and one full service reduction made, the pressure in the emergency reservoir of the last car would be about 75 lb. The brake pipe and auxiliary reservoir pressure on this car would be 69½ lb. The over-charge in the emergency reservoir, is therefore, 5½ lb. It is then possible for this emergency reservoir air to leak past the service graduating valve into the auxiliary side of the service piston and cause the brakes to creep on. This has been known to happen over an hour after leaving the terminal. The means of preventing this overcharged condition is obvious. A differential of at least 5 lb.—preferably 10 lb.—between switcher and yard line pressures and road locomotive feed valve settings has been found to minimize the possibility of this type of overcharge. This is now being done by several railroads. One road is carrying a normal road locomotive feed valve setting of 70 lb. and a switching locomotive setting of 65 lb. Another is using 80 lb. normal road locomotive feed valve pressure and a setting of 70 lb. on switchers.

BRAKE PIPE GRADIENT—UNIFORM LEAKAGE—BRAKE PIPE PRESSURE 80 LB.

No. of Cars	3 lb. leakage	5 lb. leakage	7 lb. leakage
100	1¾	3¼	4¾
125	3¼	5½	7½
150	5	7¾	10½

So much for pressures and train make-up. The testing and inspection of the train, or sections of the train, is also of great importance. Leakage, of course, should be reduced to a minimum. Five pounds per minute leakage is considered a maximum and 2 or 3 lb. can be obtained without too much effort. I have talked to yard inspectors who thought that when a train was made up in several sections the leakage of each section should be so low that when the sections were made up into a train, the accumulated leakage would not exceed 5 lb. I mean by this that if maximum leakage permitted was 5 lb., and two sections were involved, they thought each section had to be less than 2½ lb. Of course this is not true. When two or more sections having 2½ lb. leakage are put together the total brake pipe leakage will still be 2½ lb. Inspectors should be instructed to avoid trying to bring leakage in some sections down to 1 or 1½ lb. with the result that they do not have enough time to test the last section. It would be much better to test all sections and have leakage an average 3 lb. per minute.

Leakage on Long Trains

Why is it so much more important to keep leakage down on long trains than on short ones? The explanation is that when a brake pipe becomes longer (there is about 1½ miles of brake pipe in a 150-car train) it becomes increasingly difficult to force the air from the locomotive to the last car. The friction of the air on the sides of the pipe reduces the head and acts much as if the pipe were a series of orifices. Even if a brake pipe had minimum leakage on a 150-car train, the pressure on the caboose gage would be somewhat lower than the locomotive gage reading. This differential is known as gradient. Gradient rapidly increases with

* Abstract of a paper presented at a meeting of the Eastern Car Foremen's Association, New York, November 18, 1949.

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leakage. The difference between the locomotive gage and caboose gage, or gradient, on 100 cars is 1¾ lb. with 3 lb. leakage. If this train were increased to 125 cars with the same 3 lb. leakage, the gradient would be 3¼ lb. On 150 cars this gradient is 5 lb. That is a pretty fair train, but remember, on 150 cars, if we increase leakage from 3 lb. to 7 lb., the gradient goes from 5 lb. to 10½ lb. Where this excessive gradient exists, when a reduction is initiated on the road, a fast rate of runaway of brake pipe air will occur which may cause undue run-in of slack and a difficult train to handle. There may also be a point in the train where the runaway plus the service reduction will add up to approach an emergency rate and a possible undesired emergency might occur.

We have now covered two important items in train preparation: (1) The prevention of overcharge by proper control of pressures if train is made up in sections, and (2) The effects of gradient and its control by reduction of brake pipe leakage.

Another important item to test for is the assurance that all brakes apply and release properly.

The ordinary yard testing device now in use *should* consist of a ¾-in. cock, a ⅜-in. cock with a standard H-6 brake valve orifice (¼-in.) and a test gage. If smaller than a standard brake valve orifice is used, valves that might go to emergency when reduction is made at a service rate could give no trouble if reduction was made at a lesser rate through a smaller orifice such as the ⅛ in. drill pet cock in common use. In using this device the following procedure should be followed as nearly as possible: (1) Charge train or section; (2) Work train for leaks (this can be done after train is partially charged if pressed for time); (3) Make 15 lb. service reduction, lap and check brake pipe leakage. Walk for application; (4) Increase reduction to full service if leakage has not already accomplished this, and release; (5) Walk train for release.

This device will enable the inspector properly to test for everything except system leakage and a release that is comparable to that obtained on the rear of a long train. There is a device available which will test for system leakage and can be set to give a release to any length of train section from 10 to 100 cars that will be as severe as if this section were placed on the rear of a 100-car train. This device is known as the system leakage testing device and is similar to the single car test device in appearance. It consists of a rotary valve controlled by a conventional type handle, a variable orifice rotary valve calibrated for train lengths of from 10 to 100 cars, and a duplex gage with readings for feed valve and brake pipe pressures. The operating handle has four positions: (1) Quick charge: At the extreme right, in which the yard supply is allowed to flow to the brake pipe at a restricted rate; (2) Slow charge: Flow is by-passed to the variable orifice rotary which restricts the flow in accordance with the train length as set by the dial; (3) Lap: All ports blanked; (4) Application: Brake pipe pressure reduced through standard exhaust fitting.

After trying several methods of testing a train or section with the system leakage testing device the following sequence was decided upon:

1.—Blow yard line and hose (a) couple test device to train; (b) set dial to number of cars on track. Dial setting to be equal to or less than cars on track; (c) place handle of test device in No. 1 position and charge section to 70 lb. and (d) work train for leaks and correct same.

2.—Place handle of test device in No. 4 position and reduce brake pipe pressure 10 lb. (a) Return handle slowly to No. 3 position (lap) and hold in this position for a few seconds to allow air to balance in train; (b) place handle in No. 2 position, which is slow release; (c) after the gage shows an increase of 3 lb. brake pipe pressure, walk train for release on each car. Cars in which the brake fails to release are to be set out.

3.—Check system, leakage, while handle of test device is in No. 2 position. (a) The gage differential is the system leakage; (b) a differential of 4 lb. is considered to be the limit.

4.—After signal from inspectors that brakes have released, place handle of test device in No. 1 position and re-charge brake pipe to 70 lb.

5.—Place handle of test device in No. 4 position and make a 15 lb. brake pipe reduction. (a) Return handle of test device to No. 3 position which is Lap; (b) check brake pipe leakage and (c) walk train for brake application on each car.

6.—Remove testing device and couple on yard line to maintain charge.

By following this sequence it was found that the time necessary for testing a section was not materially increased over that previously used. It also gave a check on system leakage which was previously unknown.

System leakage is the leakage throughout the entire brake system and not just the brake pipe. It can only be tested for in release position and is actually the leakage which must be maintained against by the locomotive. It is possible to have a train which has low brake pipe leakage but a high gradient due to broken reservoir pipes, etc., which are lapped off when brake pipe leakage test is made. System leakage is the differential between the feed valve setting and the brake pipe pressure. The brake pipe connection is on the train side of the orifice which is sized for proper number of cars being tested. A point is reached where air cannot be forced through this orifice any faster than leakage takes it away. After this point is reached, a further increase in brake pipe pressure in the slow charge position is impossible. This differential should not exceed 5 lb. or approximately .25 cu. ft. per car per min. If all this leakage were in the brake pipe, it would be equivalent to about 7 lb. per minute. I mentioned 4 lb. differential as a maximum on the test as this is equivalent to about 5 lb. brake pipe leakage. The 5 lb. figure is generally used by the railroads as maximum permissible brake pipe leakage.

Going back to the sequence of tests, the release was made from a 10 lb. application and at a slow rate. Tests showed that this rate generally did not exceed 2 lb. per min. increase in brake pipe pressure. This slow increase in brake pipe pressure nearly duplicated the rate of increase in brake pipe pressure on the caboose of 115- to 120-car trains. This was proved by riding several trains with a recording gage attached to the end of the brake pipe in the caboose. Sections which were previously tested with the standard device having a ¾-in. cut-out cock often had cars in them on

A RECORD OF FAILURES FOR 70 DAYS

Number of AB brakes failed to release	51
Number of AB-4-12 brakes failed to release	1
Number of K brakes failed to release	51
Number of K brakes failed to apply	1
Total number of brakes condemned	104
Results of tests with the A.A.R. single car-testing device:	
Passed all tests	4
Passed all tests after brake pipe leakage was reduced	6
Passed all tests after piston travel was adjusted	2
Passed all tests after brake cylinder piston binding was eliminated (AB brakes)	3
Brake cylinder piston push rod bent (AB brakes)	1
Brake cylinder piston broken (AB brake)	1
Brake cylinder tube cracked (K brake)	1
Retaining valve exhaust plugged (AB valve)	1
Blow at quick service exhaust (AB)	1
Failed to release (AB brakes)	37
Failed to release (K brakes)	45
Failed to apply (K brakes)	1

which the brakes would release readily in a 50-car section with the ¾-in. cut-out cock in full open position but some of these same cars would not release toward the end of a long freight train where the build-up was at a rate of only 2 lb. per minute.

Although the failures between AB brakes and Type K brakes are rather evenly divided, there are approximately four times as many AB valves now in service as there are K brakes which would indicate that the percentage of failures with K brakes is far higher than with the AB.

You may think that 104 cars set out was an excessive number, but two points should be emphasized: All but four cars failed single car testing device and, therefore, should not be in service. Owners could be billed for repair of these cars; (2) Over 40,000 cars were dispatched during this period from this terminal. Those cars set out amounted to only one out of every 600 cars tested.

The real proof of the value of this device is the fact that during the 70-day period only one case of stuck brakes and no undesired emergencies were reported on trains out of that terminal. Prior to the installation of the system, leakage testing device, failures of this type on trains originating at this terminal averaged about three a week. This would tend to prove that use of this device is well worth the cost, time and effort.

Train Preparation

The final thing that should be considered in preparing a train is the proper repair of pipe leaks. Some inspectors, in an endeavor to reduce brake pipe leakage, repair pipes that are broken inside Wabcotite fittings by inserting a piece of hose gasket, tape, string or some similar material under the nut and tightening it. In most cases this will temporarily stop the leak long enough to test the train and this is about all. In order to make available to the railroads a means of repairing pipe breaks at the fitting which would be nearly as permanent as the original installation, the air brake companies, about two years ago, introduced the Wabcogrip fittings, which consist of a new nut and rubber seal and the standard Wabcotite flange fitting.

When a broken pipe is detected at the fitting, the old Wabcotite nut is removed and the new nut and seal applied to the pipe and tightened. However, service experience has shown that in order to insure uniformity of use and to avoid difficulties with pipes installed with Wabcogrip fitting parts, the manufacturer's instructions must be followed.

[Mr. Carothers included in his paper a discussion of the ABLC brake which is not included here, having been previously covered in detail in an article which appeared in *Railway Mechanical Engineer* for March, 1949, page 124.—EDITOR]

In conclusion, I would like briefly to review the salient points of yard testing:

1—Watch make-up of sections for over-charge. A 5 or 10-lb. higher feed valve setting on road power than on yard lines and switch engines should be considered.

2—Keep leakage to a minimum, especially on long trains.

3—Make sure yard testing device is standard and that application is made at a service rate.

If these points are adhered to, you will be surprised at the results. Although the use of the system leakage testing device may seem complicated at first, its operation is quite simple and it does prepare a train in such a manner that stuck brakes become a rarity even under rather unfavorable manipulation.

There are few places where so much can be gained for the railroad with so little effort expended as in proper procedure and supervision of yard testing.

Draft Gear Repairs

The heavy pneumatic press, illustrated, is used at the San Bernardino, Calif., shops of the Atchison, Topeka & Santa Fe in conjunction with draft gear repairs, in particular, although it is well adapted to handle many other heavy pressing operations. The press is shown resting on the ground in one view giving a good idea of its complete general con-

How the draft gear press is installed in the shop floor for convenient operation

Heavy pneumatic press designed for use in repairing draft gears

struction and the other set in the shop floor at the point where draft gears are assembled.

The press consists of two 12-in. channel spaced 28 in. apart and tied together at the top and bottom by heavy channel sections rigidly riveted together. A 20-in. air cylinder is mounted vertically between the channels and rigidly bolted to them, the upper end of the piston rod being connected to a horizontal plate which is guided and moves up and down between the vertical channels, as air pressure is applied to or released from the cylinder.

The press has a free working height of 35 in. for all types of draft gears, using suitable adapter blocks. It is used in dismantling and rebuilding draft gears. By taking pressure off the retaining bolt, this bolt may be cut off, or removed with a socket wrench if there is no burr.

The draft gear parts are inspected, gauged and renewed if necessary. All parts are then reassembled, pressure applied in the press and the new retaining bolt easily put in place. After each gear is thus rebuilt and adjusted to the proper height, it is blocked down $\frac{3}{8}$ in. for easy application in the coupler yoke.

Referring to the view showing a draft gear being assembled in the press, it will be noted that the steel block or head which transmits pressure to the draft gear at the top is cut away and hollowed, thus giving access to the retainer bolt and nut.

Repairing Preco Circulating Fans

Preco air-circulating fans used in refrigerator cars are repaired at one large western railway shop in a separate room equipped with an assembly bench, vise, electric drill, parts racks, etc., also a convenient and efficient test set-up on an adjoining bench, as shown in the two illustrations.

All parts of the air-circulating fans and drive assemblies are removed from refrigerator cars at general overhaul and taken to the repair room where they are dismantled, thoroughly cleaned, broken or worn parts renewed and the fans reassembled.

In the drive-assembly units, bearings are sometimes found frozen and shieves worn or broken. These are removed and replaced, also drive wheels, lift and support grommet rubbers, bearing cups, etc.

New bearings and brackets are generally required for the blower assembly which may have broken fan segments and a bent shaft. In the latter case the shaft is straightened and lined up in the new bearings.

After assembly of the blower unit, it is mounted on the bench shown, with V-belt drive from a $\frac{3}{4}$-hp. electric motor. The unit is operated for 20 min. at

Preco drive assembly at the bench for reconditioning

Repaired Preco blower assembly being "run-in" at the test bench

2,100 r.p.m. to make sure the rotating unit is in correct balance to minimize vibration and the bearings are in proper alinement.

In this way, it is positively known that the Preco air-circulating fan drive and blower unit are in good working condition before application to the refrigerator car.

Cleaning Freight Car Interiors

Car department forces at the Finley shop yard of the Southern at Birmingham, Ala., are using what they believe to be the first freight car washer of its kind in regular daily use. With it they are performing work just the opposite to that done with the more familiar car washers in use for cleaning the exteriors of passenger cars and Diesel locomotives. This washer is used to get the interiors of box cars in an absolutely clean condition for the loading of the many commodities requiring Class-A cars, of which every railroad seems to have a constant need.

Cars sent to the wash rack are shifted onto a track which has a slight incline leading to the washing location. As the cars enter this track, workmen clear out all loose debris, trash and dunnage that may have been left in the cars. All protruding nails and wire strapping are removed and the car floors are swept. Only after this work has been done are the cars allowed to roll down the track to the point where the car interiors will be washed thoroughly with a mixture of steam, water and a detergent.

The inside rail, at the washing location, is slightly lower than the outside rail to allow drainage of all water from the car. There is a concrete platform at this point, also slightly inclined, which allows water to run off into a drainage pit.

The operation requires the services of two men. One, inside the car, directs the spray from a high-pressure cleaning jet over the walls and floor (the roof also when necessary) until all removable traces of dirt or soil from previous loadings in the car have been removed. A workman on the wash rack platform tends controls which regulate the flow of water, steam and detergent into the mixing tank from which the cleaning mixture is fed to the high-pressure jet.

The capacity of the car washer is 20 to 24 cars in an eight-hour period. Similar installations are now being made by the Southern at Columbia, South Carolina, and Spencer, N. C.

Workman spraying car interior with high-pressure jet

The car cleaning installation is shown at left with a close-up of the controls for water, stream and detergent above

Maintenance of Vapor Steam Heating Equipment*

Q.—Cars on the Milwaukee have a long line for one regulator; the whole length of the car plus about 12 ft. It gives a lot of trouble waterlogging. Should we have two regulators instead of one?

A.—One thing that could be your trouble is that the No. 1671 valve is placed at the aisle and you feed about 4 ft. over to an No. 881 ell (which is the elbow for unit fin radiation), and from there down the entire length of car. The No. 881 ell was designed as a slip joint ell in the inner tube and to be placed at the far end of radiation away from the valve. Yours is just the opposite—steam feeding in the inner tube would short circuit out this slip joint and back to the return loop leaving the long radiation waterlogged and cold.

Q.—There seems to be corrosion on the seats from solder flux and it seems that every car bought has that condition,—a green corrosion around the seat of the valves. Cleaning the system thoroughly eliminates the trouble.

A.—It is difficult to get people to flush the heating system thoroughly after it has been put together. This flushing should be done with some solution that counteracts the acids.

Q.—Some cars have the No. 920 retarder on the end of the overhead radiator. Some have it under the car. Which is the proper installation?

A.—Less trouble is experienced by leaving out the retarder in the overhead return entirely. The only time you would get a steam blow from the drain tube would be if the valve was placed in the manual "on" position.

Q.—What makes the pressure valve hum?

A.—The main thing is water. Where a pocket is formed ahead of a No. 244 or No. 955, or in the presence of extremely wet steam, a condition can be set up to produce a vibration or humming. Such pockets should be trapped and drained. Also after a valve has been in service a long time the diaphragms have a tendency to take a "set," causing this condition.

Q.—On the No. 155 trap, is there any right or preferred length of nipple?

A.—As far as we are concerned it doesn't make any difference. A nipple is generally used to get condensate down below any piece of equipment on the car before discharging it to the ground. This prevents accumulation of ice on generators, battery boxes or other equipment.

Q.—What is the maximum of radiation that could be handled by one regulator?

A.—One regulator is designed with more than enough capacity to feed a whole car. Some suburban cars are heated this way. In this case the cars have high underneath frames; the regulator is located under this and feeds up to both sides, and from that to a 1672 double feed valve located in the center of car, feeding to both ends simultaneously. The 1672 has enough capacity to handle that.

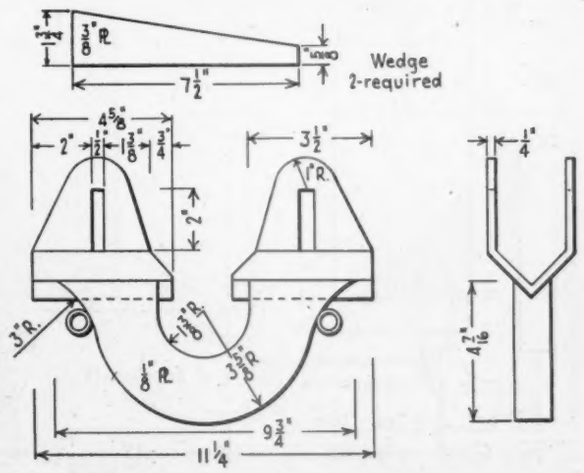
* These questions and answers, continued from the January issue, were submitted following a talk at the November meeting of the Northwest Carmen's Association by James E. Morris of Vapor Heating Corporation.

Train Line Welding

A small, light, easily applied jig has been built at the Centralia, Ill., shops of the Illinois Central to hold sections of train line together for joining by gas welding. The jig slips over the two parts to be joined and is held in place on the piping by two wedges which are tapped lightly into place with a hammer. Once set in place, the jig holds the two adjacent beveled edges of the train line snugly together in accurate alignment.

The jig consists of a clamp in which the two ends of the line to be welded are inserted, and two wedges which lock the entire assemblage in place. This holds the two ends of the line in rigid correct alignment, and butted together for welding. The wedges are attached to the clamp by link chains to keep the three parts together when not in use.

Welding the train line together with the positioning clamp



Positioning clamp for welding the train line

NEW DEVICES

Intercoolers For Air Compressors

The Wilson Engineering Corporation, 122 South Michigan ave., Chicago, has developed interstage radiation assemblies using its integrally-cast directional-finned aluminum elements fabricated to permit quick interchange, by the removal and replacement of flange bolts only, for the Westinghouse 3CD, Gardner-Denver ADX and WXE air compressors. These intercooler assemblies are factory tested to 500 lb. per sq. in.

The accompanying drawing 201-G shows the assembly for the Gardner-Denver WXE compressor used on General Motors locomotives. The assemblies for other types of compressors are similarly fabricated to meet existing installations, with the same type application. The radiation is equivalent to 40 lineal feet of 1½-in. pipe. Pipe and welding fittings are 2 in. To locate a pressure gauge or a safety valve, when desired, ¾-in. plugs are incorporated at the tops of the elements. The total weight of the assembly is approximately 120 lb.

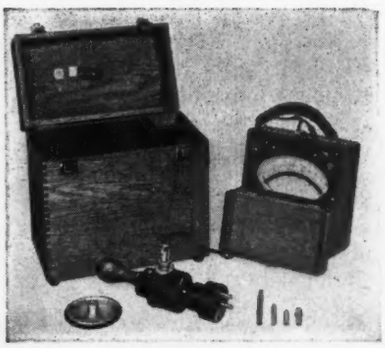
The intercoolers are designed to withstand 500 lb. per sq. in., even though required normally to meet pressures considerably less than those delivered for ultimate consumption by the high pressure stage, because they are sometimes subjected to full delivery pressure by the sticking of valves. It is customary to provide safety valves on the intercoolers to take care of this possible condition, but the impact, when it occurs, can be so sudden as to prevent complete release of pressure through the safety valve.

Electric Tachometer

A portable electric tachometer and cutmeter introduced by the Electric Tachometer Corporation, 2218 Vine street, Philadelphia 3, Pa., assures accuracy of better than ± ½ of one per cent of full scale value in measuring either surface speeds up to 5,000 ft. per min. or shaft speeds up to 25,000 r.p.m. Generating and indicating instruments are separate, and in many applications, such as in the measurement of motor speeds, it is practical to mount the indicator permanently in some convenient, remote location. The standard cable connecting the generator and indicator may be lengthened to as much as 500 ft.

The tachometer is self-contained and requires no batteries or other external power source. It consists of a precision-built d.c. magneto generator that produces a voltage directly proportional to the speed being measured, calibrated in conjunction with an easily-read laboratory type indicator having four overlapping speed ranges.

Two styles of driving points, an extension shaft, and cutmeter wheel assure easy application of the instrument to practically any type of rotating equipment.



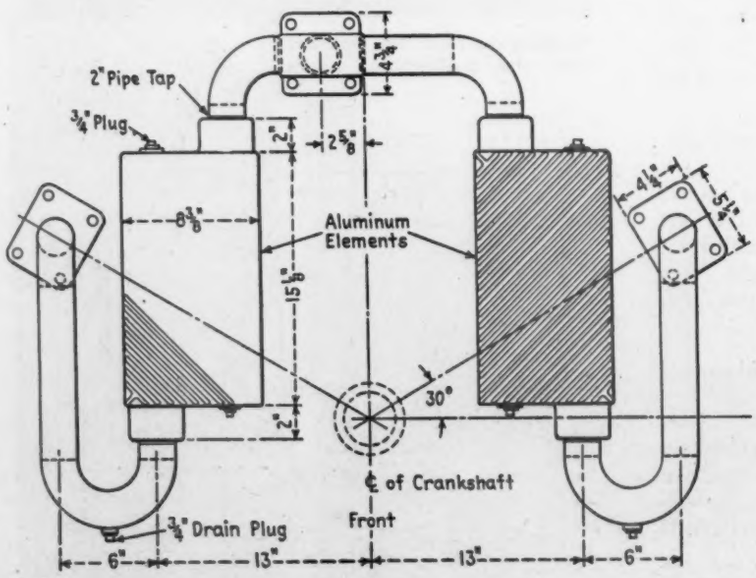
The entire assembly is housed in a convenient quartered oak carrying case.

Acid-Type Powdered Cleaner

An inhibited cleaner which does not promote corrosion has been developed primarily for cleaning the exteriors of painted railway passenger car coaches and Diesel and electric locomotives by the Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

Marketed as Pennsalt Cleaner AC-19, it is composed of a blend of acid bases and surface-active agents; the mixture being essentially dustless and easily handled. It can be applied in the normal bucket and brush fashion followed by a good water rinse.

The detergent is suitable for washing windows and is completely soluble in cold water. The product leaves no streakes of opalescence.



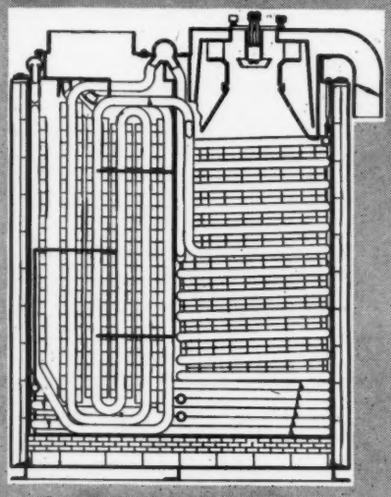
Intercooler for Gardner-Denver Compressor

General Purpose Vertical Boring Mill

A wide range of general purpose vertical mills have been made available by King Machine Tool Division of American Steel Foundries, Cincinnati 29, Ohio.

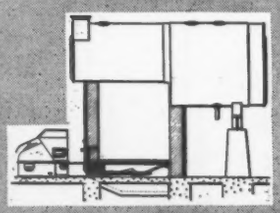
Ten sizes are in production including such popular models as 30, 36 and 42 in. capacity single column mills and 52, 62, 72, 84, 100, 120 and 144 in. double column boring mills. All of these units are obtainable in a variety of head combinations with or without the side head either in a standard design or with special variations.

Illustrated is the 42 in. model with a left-hand swivel ram head, right hand swivel turret head and side head. Many improvements in this and the other units promote greater accuracy, easier opera-



Controlled Recirculation Steam Generator for Train Heating and Stationary Applications: Capacities 2300 lb. - 3000 lb. per hr. Pressure 275 psi. Larger capacities for industrial use

ANNOUNCEMENT

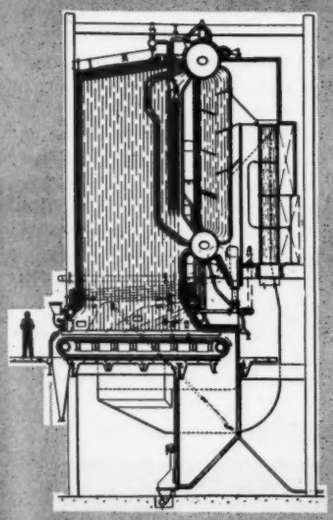


Premier Boiler fired by Skelly Stoker. Capacity 1000 lb. per hr. Pressure 100 psi.

In addition to Elesco products for steam and diesel - electric locomotives, we offer a complete line of boilers, fuel burning and related equipment for stationary and marine plants. This line provides for all conditions of steam pressure and temperature.

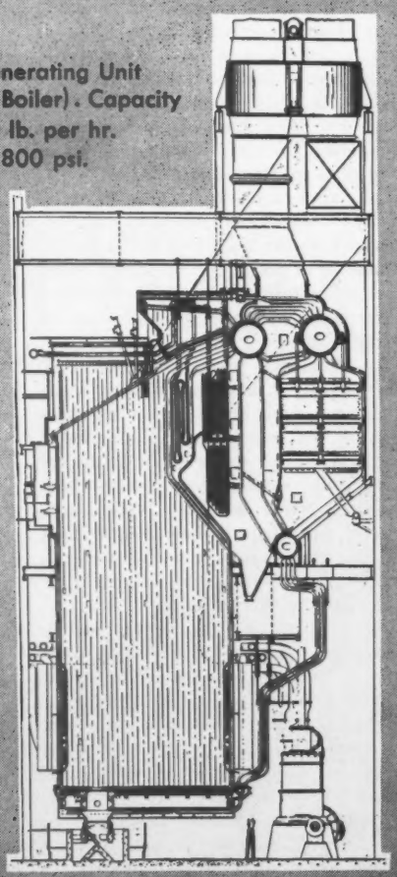
C - E Steam Generating Units are serving heating and power requirements in every branch of industry from small marine and manufacturing plants to the largest utility power stations.

Your inquiries are invited.



VU Steam Generator fired by C-E Spreader Stoker. Capacity 100,000 lb. per hr. Pressure 450 psi.

Steam Generating Unit (Type VE Boiler). Capacity 1,000,000 lb. per hr. Pressure 1800 psi.



THE
SUPERHEATER CO.
Division of
COMBUSTION ENGINEERING-
SUPERHEATER, INC.
Representative of AMERICAN THROTTLE COMPANY, INC.
60 East 42nd Street, NEW YORK
122 S. Michigan Ave., CHICAGO
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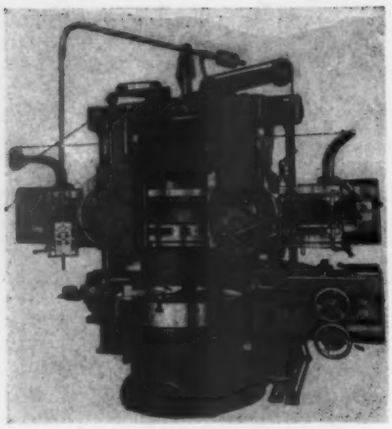
Superheaters • Superheater Pyrometers • Exhaust Steam Injectors • Steam Dryers • Feedwater Heaters • Steam Generators • Oil Separators • American Throttles



tion and longer service life. Heavier and more rigid construction, increased power, and a wider range of feeds and speeds make the vertical boring mills suited to the use of carbide cutting tools.

Inert Gas-Shielded Metallic Arc Welding

When the Air Reduction Sales Co., 60 E. 42 st., New York 17, announced a year ago the development of the Aircomatic or inert gas-shielded metallic arc welding process for the welding of aluminum, there were hints that it would also be economically available for other metals. In the intervening year, the process has been successfully applied to the welding of chrome nickel or stainless steels and aluminum bronzes.

When applied to the welding of stainless, this process has certain specific advantages over the older and better known methods. For example, the filler metal is carried across the arc and deposited in the weld virtually without loss of alloying elements.

The Aircomatic process deposits more stainless steel at a given value of welding current and hence minimizes heat effects in the base metal. The physical properties of the welded joint obtained equal and sometimes exceed those achieved by other methods. Superficially, the weld surface is without slag deposit and dull, but it grinds, buffs, and polishes to any desired finish as easily as welds made by other methods.

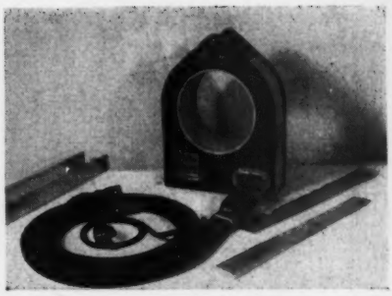
High welding speeds are obtainable. When using 1/16-in. wire, deposition rates in the down hand position of 15 lb. per arc hour are possible. Joint designs in heavy plates can be modified to have only a small included angle with large savings in welding material and time. Because only a fine wire, 1/16-in in diameter, must reach to the bottom of the weld groove, the included angle may be reduced to 30 deg. The diameters of wire available are 0.035, 0.045 and 1/16-in. in AISI Types 310, 316 and 347.

Induction Pinion Heater

An induction heater for removing traction motor pinions is now being manufactured by the National Electric Coil Company, Columbus, Ohio. Use of the heater eliminates the high-tonnage pressures involved when pinions are removed by means of a mechanical puller. It also disposes of the shock to bearings which is caused by the "re-active kick" when a pinion breaks loose. When an induction heater is available, it is never necessary to use an acetylene torch to remove stubborn pinions.

The operation of removing a pinion consists first of placing wedges between the pinion and the bearing housing and driving them up snug with a light hammer. The heater is then placed around the pinion, a ground clip is attached to a bolt head on the motor, and the power cable carrying the ground wire is excited from a 440-volt, 60-cycle power source. In less than two minutes sufficient internal heat is generated within the pinion, so that the pressure from the wedges will cause it to come off. Before heat is applied, the pinion is backed off and replaced one or two turns. This keeps the pinion from falling off when it breaks loose. The heater is insulated with A.I.E.E. Class H materials to insure long life. It may be operated easily by one man. It causes heat to be generated by induction in the pinion. Due to skin-effect, this heat is generated largely in the periphery of the pinion and is conducted toward the center. The pinion comes off before the heat reaches the shaft. Maximum temperatures are well within safe limits.

To rapidly induce heat in the pinion, it is essential to have a good magnetic coupling between the coil and the pinion. Coils in various sizes are available for all pinion diameters. The same plug and cable connection can be used with all coils.



The heater complete with wedges, ground and power connections

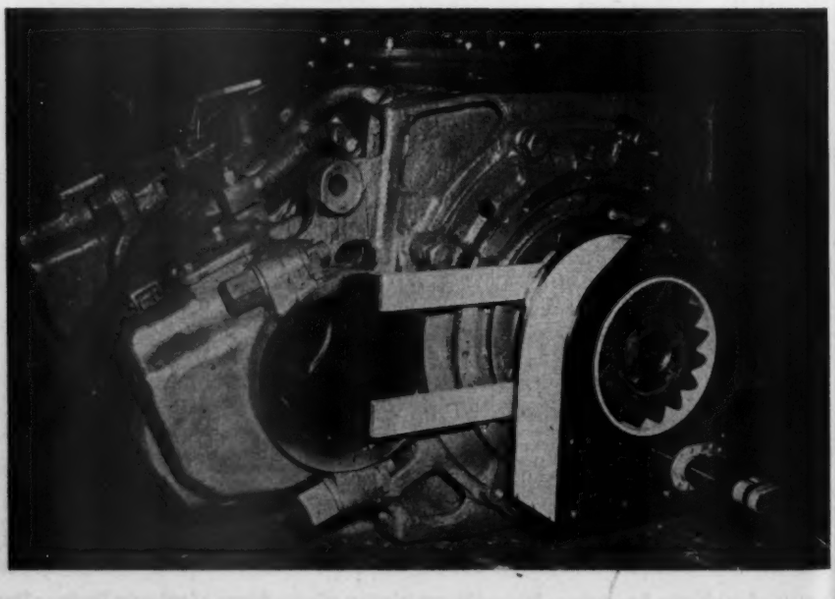
Universal Hydraulic Testing Machine

Designed like larger Baldwin machines with hydraulic loading unit separate from the indicating and control unit is the Model 60-H universal testing machine of 60,000-lb. capacity with two ranges recently announced by The Baldwin Locomotive Works, Philadelphia 42, Pa.

A feature of the unit is its rigid, two-column design which gives high accessibility in handling specimens and simplifies observations. Load is applied by an integrated piston and elevating cage consisting of the table, two uprights and upper gripping head, all of which have a 6-in. stroke. The lower gripping head is the upper member of a second, adjustable cage including two long columns and lower crosshead supported by a vertical screw extending downward from the closed end of the hydraulic cylinder.

A motor-drive for positioning the lower gripping head within the loading cage, is also a new feature as standard equip-

The heater applied to a traction motor with wedges behind the pinion



Along with Electro-Motive leadership
in engineering and manufacture has come
leadership in service through the first nation-
wide organization of parts warehouses, repair shops
and strategically located service engineers. That's
one reason why General Motors locomotives are first
choice in the fast-growing Diesel fleets of America's
leading railroads.

ELECTRO-MOTIVE DIVISION

General Motors, La Grange, Illinois

Home of the Diesel Locomotive

ment. The motor-drive, including worm gear and nut on the adjusting screw, is mounted on the lower crosshead, giving a range of 17 in. at 10 in. per min. Loading controls giving infinitely variable speed between 0 and 2 in. per min., are located on the table of the control cabinet. The flow of oil to the cylinder is controlled by a directional control valve for up and down motion and two vauves, for coarse and fine control of testing speeds. Automatic safety devices protect gages against overloads and prevent over-travel of moving parts.

The 60,000-lb. range is graduated in 100-lb. units on a 16-in. diameter indicator dial and a 12,000-lb. range is graduated in 20-lb. units. Bourdon gages for both ranges are the Emery type, with accuracy within 1 per cent or one dial division, whichever is greater. They are connected directly with the loading cylinder.

D. C. Motors

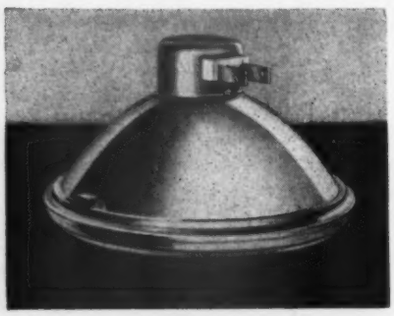
Type K, direct-current Life-Line motors, in 1- to 30-hp. ratings, are available from Westinghouse Electric Corporation, East Pittsburgh, Pa. These motors retain the basic design of earlier SK motors, but feature the same all-steel construction used in the a.c. Life-Line motors.

Heavy steel and brackets assure strength, rigidity, and correct bearing alignment. Pre-lubricated sealed-for-life ball bearings provide effective lubrication without attention. No greasing program is needed for the life of the bearings. The motors, in frames 203 to 365, are available for constant, adjustable, or varying speed applications; for either continuous or intermittent service. Depending upon the use intended, the motors can be supplied with shunt, compound, or series windings. They are designed for operation from 115, 230, 550, or 660 volts.

Long Range Spotlight

A sealed beam type spotlight lamp intended for long range indoor and outdoor illumination applications has been announced by General Electric's Lamp Department, Nela Park, Cleveland, Ohio.

The lamp is described as a compact spotlight of high candlepower, consuming 200-watts, and projecting a narrow beam of approximately 20 deg., or about one-



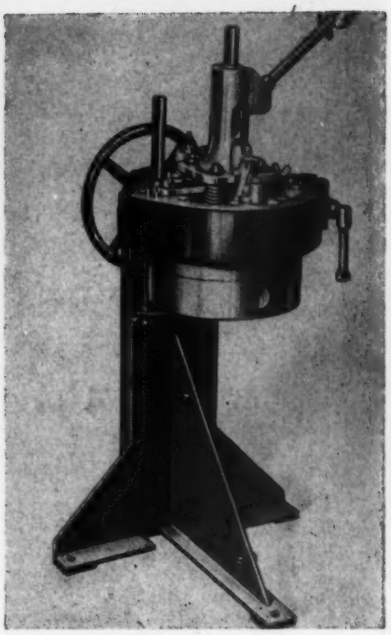
half the beam spread of spot lamps now available. It is designed especially for effective spotlighting of targets from relatively high or distant locations. In short, it is said to shoot more like a rifle than a shotgun.

Called the Narrow-Beam Projector Spot, the lamp is equipped with a side-prong base and a compact bulb of pressed heat-resistant glass. Its initial maximum beam candlepower is given at approximately 50,000. The lamp is suitable for interior lighting in large railroad stations, and for lighting of small signs from remote points for protective lighting along fences, etc.

For outdoor service, it is recommended that the lamp be mounted in a holder designed to protect the connector.

Diesel Valve Spring Depressor

The illustrated device named Safe-N-Ezy is a Diesel valve spring depressor for Type EMC 567 and 567A Diesels which has recently been introduced by the Paxton Diesel Engineering Co., Omaha 5, Neb.



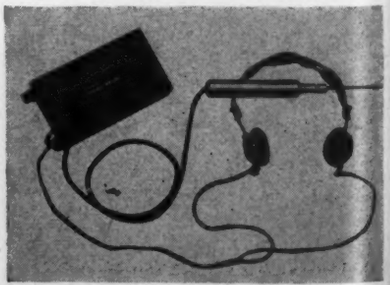
In contrast to previous spring depressors, this Model D-14 depresses four springs simultaneously. Earlier models accommodated only a single spring at a time.

Because this unit depresses four springs in a single operation, a saving of over 50 per cent in time and labor on dismantling and assembling Diesel valves is claimed.

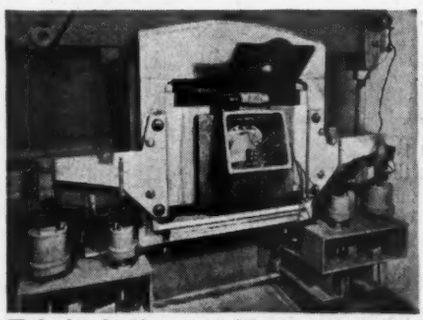
The depressor is compact, lightweight, rugged, and is designed for easy, safe, one-man operation. It includes a stud with a base plate having wing bolts for quick attachment to the head. Compressing the springs to the desired point, the tool safely holds them in position, leaving the mechanics' hands free to proceed with the work. A simple, safe, easily operated device controls the release of the depressor.

Electronic Sound Probe

A completely redesigned sound probe utilizing the principles of electronics is announced by the Como-Tex Company, 128 W. Lake street, Chicago 1. The manufacturer states that the device localizes sound and permits the user



Resistance of A.A.R. Solid Bearings not affected by temperature—*EVEN AT 30 BELOW!*

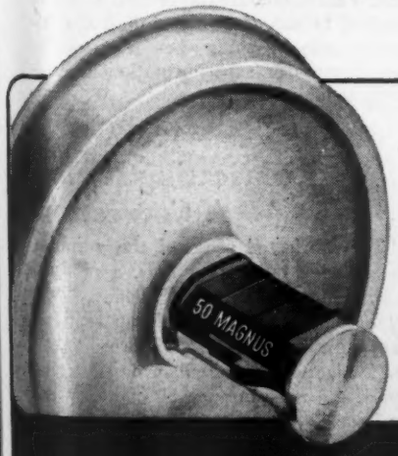


With this highly special laboratory equipment developed by the A. A. R. Mechanical Division, journal resistance can be separated from all other elements of resistance in train operation.

TESTS HAVE PROVED that during winter operation the maximum initial accelerating resistance of the solid bearing is uniformly less than that imposed by any other type of bearing assembly—averaging approximately 6½ lbs. per ton as compared to some resistances of over 45 lbs. per ton for other bearing types. Moreover, solid bearings, unlike other types of bearings, do *not* materially reflect the increased overall train resistance experienced in adverse winter weather.

Of course, bearing resistance, in itself, is ordinarily an insignificant factor in train operation. But under extreme winter conditions—with iced tracks and snow-packed road beds—this lower resistance of the solid bearing can help you *move* the maximum tonnage for a given draw bar pull.

Write for additional data.



No other type of bearing offers you all of these service-proved advantages

MAXIMUM DEPENDABILITY: In daily operating service, an unequalled record for bearing assembly performance.

SMOOTHEST RIDING QUALITIES: Lateral shocks are flexibly controlled—not rigidly opposed. More miles per wheel set.

LOW ACCELERATING AND RUNNING RESISTANCE: Glides on a single film of oil, like a skater on ice. No complicated moving parts.

EASE OF MAINTENANCE: Can be fully inspected or replaced on the line in about 10 minutes. No shopping required.

UNIVERSAL INTERCHANGEABILITY: Simple — dependable — economical — safe.

LIGHT WEIGHT: Saves more than 100,000 pounds dead weight per hundred car train.

ROCK BOTTOM COST: Saves over 25% on total car cost.

MAGNUS METAL CORPORATION • Subsidiary of NATIONAL LEAD COMPANY
New York, Chicago

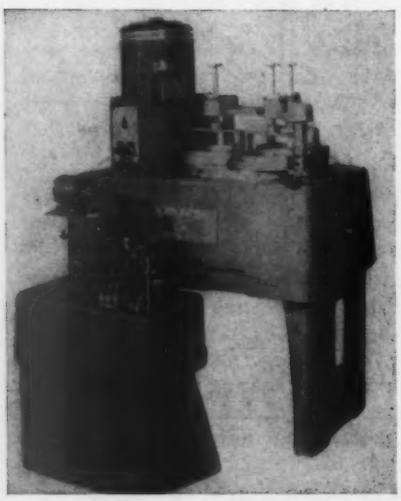
accurately to trace it to its source. It was designed to take the place of the welding rods, pieces of steel, mechanical stethoscopes, etc., which are widely used by mechanics and engineers.

The electronic sound probe brings out a natural reproduction of noise at the source, but greatly amplified, and without distortion. Extraneous sounds are excluded and the sound being investigated can be identified by its character.

Lapping Machine Is Self-Conditioning

The Lapmaster, a development of the Crane Packing Company, 1800 Cuyler avenue, Chicago 13, is applicable to production runs or individual jobs, and can be operated by unskilled workmen. Work of different sizes, shapes and heights can be handled simultaneously in one operation.

The machine embodies a continuously agitated compound tank, an alloy-iron lapping plate driven by a gear reduction motor, and combined work-holders and



conditioning rings which are held in place by adjustable bars. The lapping cycle time is automatically controlled by a clock, which stops the lapping plate and closes the compound valve at the end of a predetermined period. Tapered roller bearings furnish support to the lap plate.

Among the features of the Lapmaster is the continuous self-conditioning of the lapping plate which affords controlled and continuous accuracy in flat, concave, and convex lapping up to .000016 in. The continuous conditioning of the lapping surface is the result of the design which allows the conditioning rings to wear the lapping plate through the entire lapping cycle at a faster rate than the wear caused by the work. The combined conditioning rings and work-holders of the Lapmaster rotate within their own orbit on the face of the lap. The lap rotates under the work, and the conditioning rings rotate on the lap. The work, in turn, is free to rotate on its own axis in the work-holders.

The Model 12 Lapmaster is equipped with a 12-in. lapping plate and three conditioning rings, each with an internal capacity of 4¼ in. The Model 24 has a 24 in. lapping plate and is furnished with three conditioning rings 9¾ in. diameter or four conditioning rings of 8¼ in. diameter. Four other models are available, with lapping plates of 36, 48, 60 or 72 inches.

Oil Filter Adapters

One of the features of the Morrow cartridge filters or replacements, previously described, is that a single type, the model DR-100 may be used for either the Michiana or Nugent filter tanks usually installed as original equipment in EMD, Alco, Baldwin and Fairbanks-Morse locomotives. This is made possible through the use of RA-1 and RA-2 adapters developed by The Morrow Filter Co., Inc., Towson 4, Md.

Type RA-1 for Michiana filters consists of a polished brass tube 28 5/16 in. long and 1¾ in. dia. This tube is perforated and slides over the perforated Michiana Wastex can tube, fits snugly and rests firmly over the spud at the base of the Michiana tube.

The RA-2 adapter consists of a stamped steel plate, drilled in the center to fit snugly over the built-in center tube within the Nugent individual element cans. The center hole is sealed with a "O" ring oil-resistant seal to prevent by-passing from under the replacement.

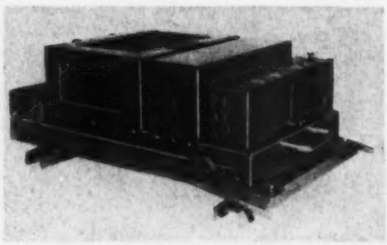
The DR-100 replacement rests upon the spring-supported plate and compresses the spring to approximately 60 lb. pressure when the cover is in place.

Vibrator Converters

A new line of vibrator converters, designed specifically for railroad communications and power conversion requirements, has been announced by the Cornell-Dubilier Electric Corporation, 2900 Columbia avenue, Indianapolis, Ind. These converters are available in models for operation on 32-, 64- and 120-volt, d.c. input. All units have an output rating of 115 volts, a.c., 60 cycles at 375 volt-amperes.

For installation convenience and ease of maintenance, the converters are mounted on specially designed racks. Converters can be removed from the racks by releasing two bolts. There are no wires to disconnect. The over-all size of the converters mounted on racks is 26½ in. x 18 in. x 10 in.

Some of the operating advantages claimed by the makers are first cost reductions up to 60 per cent and low



maintenance costs. No lubrication is required, and there are no commutators to clean. Unskilled personnel can remove or install replacement vibrators. Service interruptions are prevented by a standby vibrator which automatically picks up load at the end of service vibrator life. The service vibrator can be replaced at terminal or repair point without communications interruption during a trip.

Zinc Alloy Die Foundry Simplifies Maintenance

The Chambersburg Engineering Co. Chambersburg, Pa., has announced the establishment of a new die service for the convenience of Cecostamp users. The Cecostamp is an air operated, impact drop stamp which is capable of forming a wide variety of shapes from all formable metals.

Originally developed for the formation of sheet metal aircraft sections, use of the stamp has been extended to numerous other metal-forming operations. Sections of railroad cars are listed among the products now being formed with the Cecostamp.

Convenient sources of these dies have not been heretofore available, except where users put them in their own die shops. Now, the development of a zinc alloy die foundry at Chambersburg makes a ready source of these dies available to both prospective and current Cecostamp users.

Manufacture of zinc alloy dies will be in accordance with current recognized techniques.

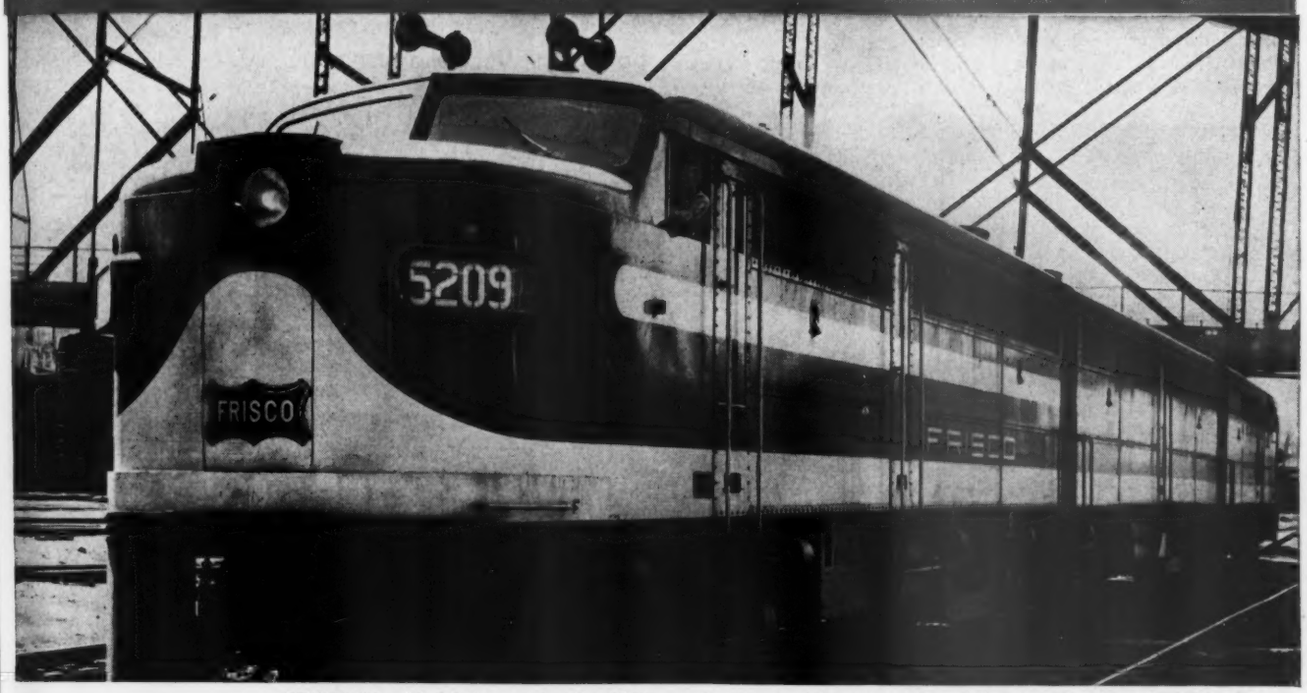
Zinc alloy dies are recommended for stamping operations where economy is more to be desired than long production runs. Fabricated in days, instead of weeks required to make hard metal dies, zinc alloy dies effect savings when frequent design changes or experimentation necessitate new tooling.

Lubricating Rods—A Correction

"The lubricated area" of the graphite wheel flange lubricating rods, a product of the National Carbon Company, "will *not* become sticky and pick up sand or other abrasive material." The word "not" was inadvertently omitted in our description of the rods on page 50 of the January issue.

KEEPS DIESELS CLEANER

That's why Texaco Dieseltex HD assures greater locomotive availability, lower maintenance costs



FRISCO Diesel freight locomotive No. 5209 — an Alco 3-unit, 4500 h.p. engine — is lubricated with Texaco Dieseltex HD.

More and more railroads are turning to *Texaco Dieseltex HD* because their exacting tests show that this superior railroad Diesel engine lubricating oil assures more mileage between overhauls, better performance, greater operating efficiency and economy.

Texaco Dieseltex HD is both detergent and dispersive . . . and its exclusive formula contains a special heavy-duty additive that assures exceptional resistance to oxidation and sludge formations. Thus engines run with cleaner top decks and rings free . . . unhampered by harmful carbon, varnish and gum. Wear is definitely minimized.

Texaco Dieseltex HD meets the stringent requirements of leading Diesel locomotive builders and the most severe conditions of operating service. Here is a notable example of Texaco quality . . . one more reason why more *Diesel locomotives in the U. S. are lubricated with Texaco than with any other brand!*

Get improved Diesel performance and reduced costs by using *Texaco Dieseltex HD* and Texaco's unique systematic engineering service. A Texaco Representative will gladly give you full details. Just call the nearest Railway Sales office listed below, or write:

The Texas Company, *Railway Sales Department,* 135 East 42nd Street, New York 17, N. Y.

NEW YORK • CHICAGO • SAN FRANCISCO • ST. PAUL • ST. LOUIS • ATLANTA

TEXACO

TEXACO Dieseltex HD

FOR ALL RAILROAD DIESELS

TUNE IN . . . TEXACO presents MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.

NEWS

A. C. Browning Retires

A. C. BROWNING, secretary, Mechanical Division, Association of American Railroads, with headquarters at Chicago, retired on December 31. Fred Peronto, assistant secretary, succeeds Mr. Browning as secretary. Mr. Peronto is succeeded by A. I. Ciliske.

Mr. Browning was born at Belpre, Ohio, on July 15, 1884, and was educated at Mountain State Business College, Parkersburg, W. Va. He entered railroad service in January, 1906, as a truckman in the Chicago, Rock Island & Pacific's freight house at Chicago, and subsequently worked in various capacities in the local freight office at Chicago, including those of yard clerk, stenographer, waybill clerk, assistant accountant and chief tonnage clerk. In 1917 he was appointed inspector of weights and fuel clerk in the Rock Island's general office. Mr. Browning became associated with the Mechanical Division, A.A.R., in February, 1919, serving as committee reporter, mechanical inspector, and assistant to secretary until January, 1942, when he was appointed secretary.

A. C. Browning

Fred Peronto

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE JANUARY ISSUE

DIESEL-ELECTRIC LOCOMOTIVE ORDERS

Road	*No. of units*	*Horse-power*	*Service*	*Builder*
Atlantic Coast Line	5[1]	2,250	Pass.	Electro-Motive
	36[1]	1,500	Frt.	Electro-Motive
	9[1]	1,200	Switch	Electro-Motive
	23[1]	1,500	Road switch	Electro-Motive
Indianapolis Union	5[2]	1,000	Switch	Fairbanks, Morse
Lehigh Valley	5	1,000	Switch	Baldwin Loco.
	1	1,200	Switch	Electro-Motive
	3	1,500	Road switch	American Loco.
Reading	30[3]	1,500	Road	Electro-Motive
St. Louis-San Francisco	14[4]	2,250	Pass.	Electro-Motive
Western Maryland	12[5]	1,500	Frt.	Electro-Motive
	4[5]	1,500	Road switch	Electro-Motive
	4[5]	1,500	Road switch	American Loco.

FREIGHT-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Chicago, Burlington & Quincy	1,400[6]	Box	Co. Shops
	800[6]	Hopper	Co. Shops
Lehigh & New England	35	70-ton covered hoppers	Bethlehem Steel
Louisville & Nashville	500	50-ton box	Pullman-Standard
Merchants Despatch Transportation Corp.	500	40-ft. refrig.	Co. Shops
Missouri Pacific	60[7]	Cabooses	Co. Shops
Northern Pacific	500	50-ton box	Co. Shops
	50[8]	Cabooses	Co. Shops
Wabash	400	50-ton hopper	Co. Shops
Western Fruit Express Co.	450[9]	50-ton refrig.	Pacific Car & Fdry.

FREIGHT-CAR INQUIRIES

Road			
Bangor & Aroostook	200	50-ton box	
Chicago, Rock Island & Pacific	1,000	50-ton box	

PASSENGER-CAR ORDERS

Road	*No. of cars*	*Type of car*	*Builder*
Chicago, Burlington & Quincy	30[5]	Bagg.-express	Co. Shops

[1] Deliveries to be completed in May. When the new motive power is received a large number of old steam locomotives will be sold or scrapped.
[2] For April delivery.
[3] Approximate total cost $5,000,000.
[4] For delivery during first half of 1950.
[5] For delivery February and March.
[6] Building program announced by President H. C. Murphy for 1950.
[7] Steel platform cupola type. To cost approximately $472,000.
[8] Cupola type.
[9] Estimated cost $3,700,000. Delivery scheduled for second quarter of 1950.

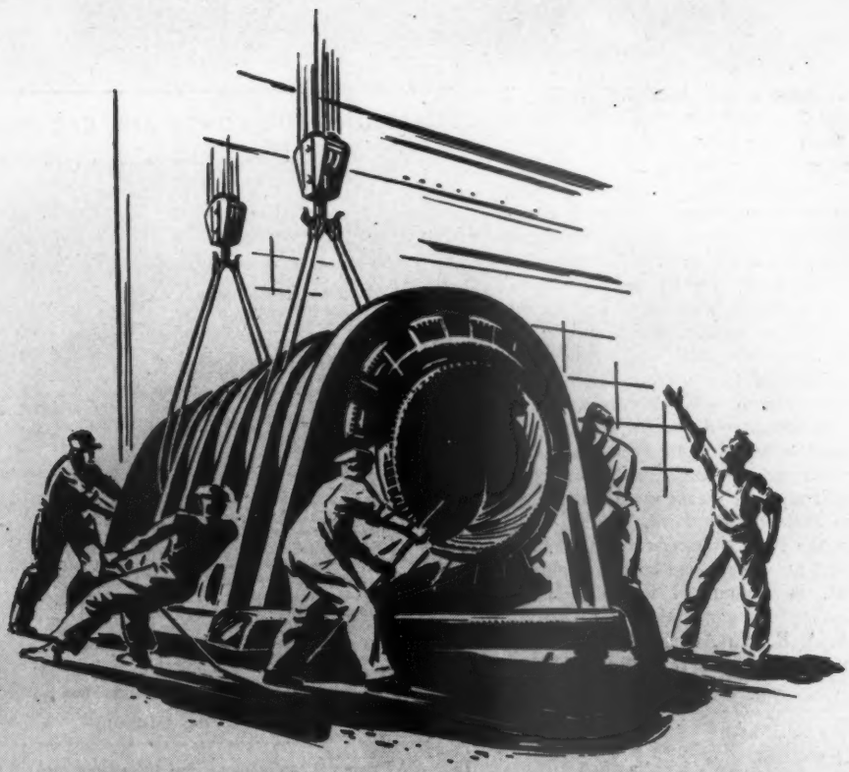
NOTES:

Louisville & Nashville.—The L. & N. has appropriated $11,000,000 for purchase of 52 new Diesel-electric locomotives and 500 box cars, and for construction of passing tracks, oil fuel stations and maintenance facilities for Diesels. Bids for the locomotives are in expectation that deliveries can be started next April and completed before the end of 1950. To be purchased are 37 road freight locomotives of 1,500 hp. each, 6 switchers of 1,000 hp. or 1,200 hp. and 9,660-hp. switchers. The box cars are to be 40½ ft. long and will be steel sheathed. The new locomotive units will replace older steam locomotives.

Missouri Pacific.—The federal district court at St. Louis, Mo., has authorized the Missouri Pacific Lines to purchase 34 freight, 8 passenger and 21 switching Diesel locomotives at a cost of $11,299,900. The orders will include 50 locomotives for the M. P., 8 for the Gulf Coast Lines and 5 for the International-Great Northern.

New York, New Haven & Hartford.—The first of 27 new sleeping cars, each costing $125,000, which the New Haven expected to put in use before the end of January, went into service December 15 on "The Owl," sleeping car express between Boston, Mass., Providence, R. I., and New York. These first were two all-room cars, with 14 roomettes and four double bedroomsE.ach car is of stainless-steel construction. The balance of the new cars, built by the Pullman-Standard Car Manufacturing Company, it was expected would be delivered at the rate of about four a week.

The directors of the road have allocated $1,450,000 out of November and December earnings for deferred maintenance, of which $650,000 is to be used for repair to Diesel-electric locomotives. Of the special reserves of $900,000 set aside from 1948 operations, the road said, approximately $400,000 is still unexpended and will continue to be held for repairs to commuter cars on the west end of the line.



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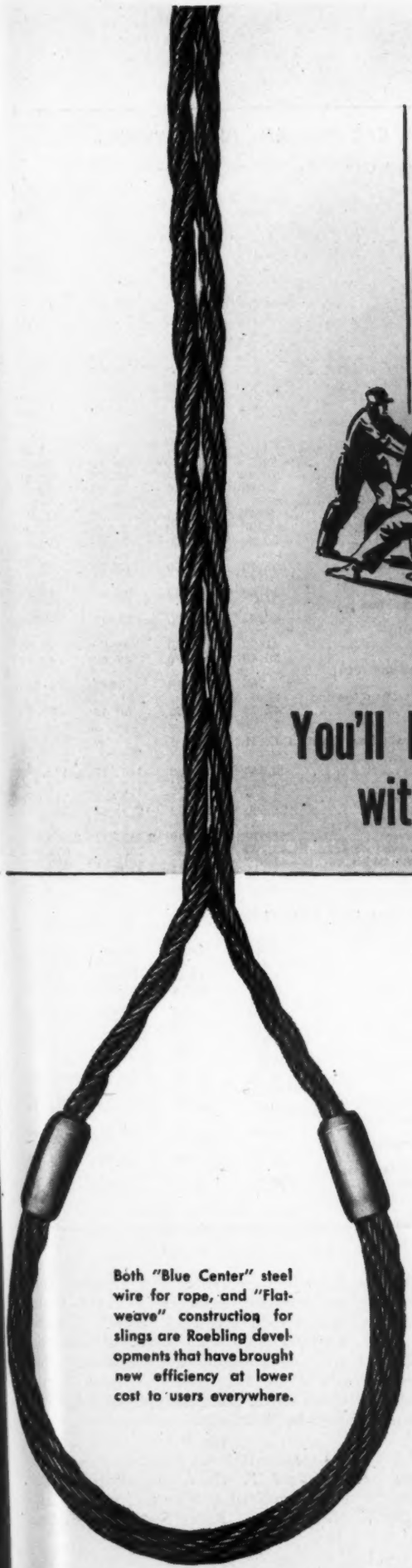

Both "Blue Center" steel wire for rope, and "Flatweave" construction for slings are Roebling developments that have brought new efficiency at lower cost to users everywhere.

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In the next place, "Flatweave" Slings are easier and faster to handle. They are very flexible and kink resistant. You can pass them through and under loads of minimum clearance. And besides that, they are free of unnecessary fittings. Heavy thimbles and servings are not needed with the specially-reinforced loops of "Flatweave" Slings.

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Mr. Peronto was born on April 27, 1898, at Sturgeon Bay, Wis. He graduated from high school in 1917 and the following year attended Lawrence College, Appleton, Wis., entering military service in World War I before the expiration of the school term. He began his railroad career in May, 1920, as a car repairer on the Chicago & North Western at Manitowoc, Wis., and served successively as car inspector and interchange inspector until 1928, when he was transferred to Proviso, Ill., yards as assistant foreman. Mr. Peronto was promoted to traveling A. A. R. inspector in 1936, and transferred to Fremont, Neb., as general car foreman in 1939. In 1940 he was transferred as general car foreman to Belle Plaine, Iowa. After representing the North Western as equipment inspector at various car-building plants in 1941, in January, 1942, he became assistant to secretary, Mechanical Division, A. A. R. In August, 1947, he was appointed assistant secretary of the Division.

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

FREIGHT SERVICE (DATA FROM I.C.C. M-211 AND M-240)

Item No.		Month of September 1949	Month of September 1948	Nine months ended with September 1949	Nine months ended with September 1948
3	Road locomotive miles (000) (M-211):				
3-05	Total, steam	29,118	44,389	303,108	411,009
3-06	Total, Diesel-electric	13,032	9,391	109,396	74,287
3-07	Total, electric	726	938	7,297	8,738
3-04	Total, locomotive-miles	42,882	54,718	419,815	494,037
4	Car-miles (000,000) (M-211):				
4-03	Loaded, total	1,462	1,770	13,478	15,397
4-06	Empty, total	764	889	7,737	8,028
6	Gross ton-miles—cars, contents and cabooses (000,000) (M-211):				
6-01	Total in coal-burning steam locomotive trains	45,446	72,850	482,441	650,410
6-02	Total in oil-burning steam locomotive trains	14,086	20,253	133,532	189,127
6-03	Total in Diesel-electric locomotive trains	37,467	27,679	313,484	215,650
6-04	Total in electric locomotive trains	1,918	2,406	19,694	21,640
6-06	Total in all trains	98,938	123,195	949,238	1,076,889
10	Averages per train-mile (excluding light trains) (M-211):				
10-01	Locomotive-miles (principal and helper)	1.05	1.07	1.06	1.07
10-02	Loaded freight car-miles	38.10	37.00	36.10	35.60
10-03	Empty freight car-miles	19.90	18.50	20.80	18.60
10-04	Total freight car-miles (excluding caboose)	58.00	55.50	56.90	54.20
10-05	Gross ton-miles (excluding locomotive and tender) (000)	2,579	2,573	2,545	2,493
10-06	Net ton-miles (000)	1,152	1,228	1,149	1,175
12	Net ton-miles per loaded car-mile (M-211)	30.20	33.20	31.80	33.00
13	Car-mile ratios (M-211):				
13-03	Per cent loaded of total freight car-miles	65.70	66.60	63.50	65.70
14	Averages per train hour (M-211):				
14-01	Train miles	17.00	16.30	16.90	16.10
14-02	Gross ton-miles (excluding locomotive and tender) (000)	43,203	41,276	42,412	39,578
14	Car-miles per freight car day (M-240):				
14-01	Serviceable	41.20	47.80	42.20	45.90
14-02	All	38.40	45.60	39.80	43.90
15	Average net ton-miles per freight car-day (000) (M-240)	763	1,010	804	952
17	Per cent of home cars of total freight cars on the line (M-240)	49.70	37.50	50.40	37.90

PASSENGER SERVICE (DATA FROM I.C.C. M-213)

3	Road motive-power miles (000):				
3-05	Steam	14,088	18,750	144,217	178,198
3-06	Diesel-electric	12,863	11,024	112,416	93,790
3-07	Electric	1,559	1,767	14,938	16,123
3-04	Total	28,509	31,548	271,684	288,149
4	Passenger-train car-miles:				
4-08	Total in all locomotive-propelled trains	272,679	300,290	2,538,832	2,679,470
4-09	Total in coal-burning steam locomotive trains	73,790	106,371	755,857	974,363
4-10	Total in oil-burning steam locomotive trains	41,672	51,375	401,031	493,833
4-11	Total in Diesel-electric locomotive trains	140,195	122,920	218,804	1,036,495
12	Total car-miles per train-miles	9.37	9.35	9.16	9.15

YARD SERVICE (DATA FROM I.C.C. M-215)

1	Freight yard switching locomotive-hours (000):				
1-01	Steam, coal-burning	1,464	2,472	16,425	23,532
1-02	Steam, oil-burning	240	383	2,496	3,510
1-03	Diesel-electric[1]	2,066	1,691	17,688	14,580
1-06	Total	3,796	4,574	36,845	41,889
2	Passenger yard switching hours (000):				
2-01	Steam, coal-burning	76	110	839	1,120
2-02	Steam, oil-burning	14	19	142	183
2-03	Diesel-electric[1]	212	188	1,858	1,659
2-06	Total	336	352	3,154	3,277
3	Hours per yard locomotive-day:				
3-01	Steam	7.40	10.50	8.30	10.50
3-02	Diesel-electric	17.40	18.50	17.40	18.30
3-05	Serviceable	13.40	14.30	13.40	14.10
3-06	All locomotives (serviceable, unserviceable and stored)	10.90	12.60	11.20	12.40
4	Yard and train-switching locomotive-miles per 100 loaded freight car-miles	1.80	1.80	1.89	1.88
5	Yard and train-switching locomotive-miles per 100 passenger train car-miles (with locomotive)	0.77	0.73	0.77	0.76

[1] Excludes B and trailing A units.

SUPPLY TRADE NOTES

PEERLESS EQUIPMENT COMPANY.—*William E. Gray*, vice-president in charge of engineering for the Peerless Equipment Company, Chicago, has been elected first vice-president.

◆

DAMPNEY COMPANY OF AMERICA.—The St. Louis Railway Supply Company, St. Louis 6, Mo., has been appointed to handle the sale of the Dampney company's expanded line of specialty coatings to a number of railroads running south and west from St. Louis, Mo.

◆

INLAND STEEL COMPANY.—*Anthony M. Ryerson* has been appointed assistant general manager of sales for the Inland Steel Company, succeeding *Neele E. Stearns*, recently elected executive vice-president of the Inland Steel Products Company, a subsidiary of Inland Steel.

◆

GRIFFIN WHEEL COMPANY.—*John W. Brittingham* has been elected vice-president and a director of the Griffin Wheel Company, Chicago. Mr. Brittingham, who became associated with the company in 1937, will continue to serve as treasurer, the position for which he was named in 1947. *James P. Maher*, sales representative of the Griffin Company, has been appointed assistant vice-president, with headquarters at Chicago.

Mr. Maher joined Griffin Wheel at the New York office in January, 1925. After serving in various capacities there and in Cleveland, Ohio, he was transferred to the general sales office at Chicago in 1934.

◆

EUTECTIC WELDING ALLOYS CORPORATION.—*Harold Duncan* has been appointed assistant regional manager of the Eutectic Corporation. Mr. Duncan, formerly district engineer in Texas, is in charge of a group of Eutectic District Engineers, servicing users of Eutectic products throughout the southwest. Texas offices are maintained at 3852 Turtle Creek Drive, Dallas, and at 1213 Capital Avenue, Houston.

◆

CARNEGIE-ILLINOIS STEEL CORPORATION.—*Clifford F. Hood*, president of the *American Steel & Wire Co.*, a subsidiary of the United States Steel Corporation,

MEMO

To: DIESEL-ELECTRIC OPERATORS

Subject: DIESEL-ELECTRIC CARBON BRUSHES

This bulletin is the first of a series on Carbon Brushes being offered free by National Carbon Division, Union Carbide and Carbon Corporation.

For Diesel-Electric maintenance and operating men, the bulletins present fundamental information on the many aspects of carbon brush usage. Typical subjects covered will be "Commutation of D-C Machines"..."Preparation and Care of Commutator"..."Analysis of Brush Operation"..."Useful Tests"... and many similar subjects.

The bulletins are technical in nature and are worthy of close study. The information contained is the best to be found anywhere and the combined series should be a valuable addition to the technical library of anyone interested in efficient Diesel-Electric operation.

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has been elected president of the Carnegie-Illinois Steel Corporation, another U. S. Steel subsidiary. Mr. Hood succeeds *Charles R. Cox*, resigned. *Harvey B. Jordan*, vice-president in charge of operations of American Steel & Wire in Cleveland since 1939, has been elected president. *James E. Lose*, vice-president in charge of operations of Carnegie-Illinois Steel, has been elected to the newly created position of executive vice-president.

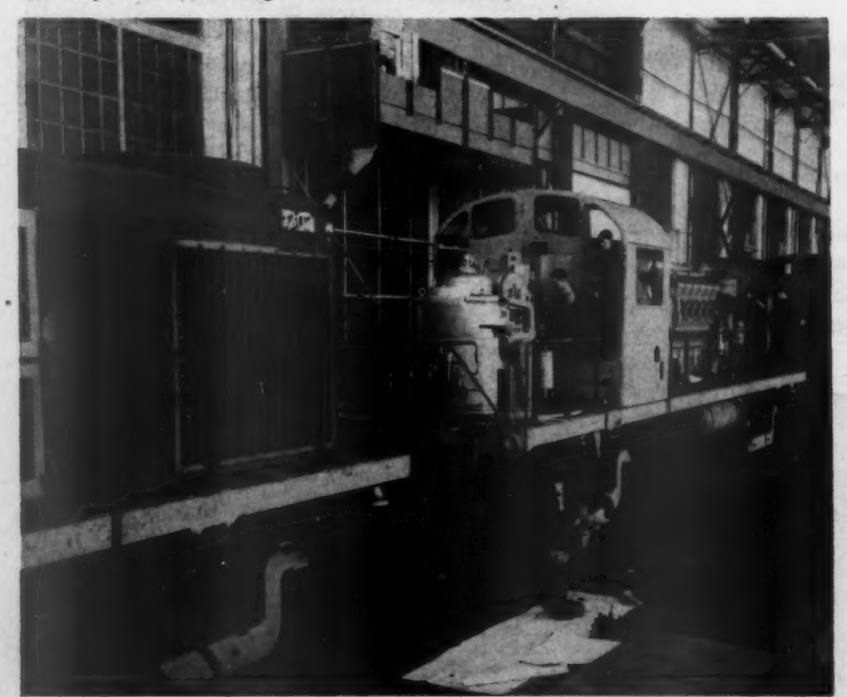
◆

MONTREAL LOCOMOTIVE WORKS.—On December 21, on the occasion of the delivery of the seventy-fifth Canadian-built Diesel-electric locomotive, the Montreal Locomotive Works, the Canadian General Electric Company, and the Dominion Engineering Works announced to a party of Canadian press and business-paper representatives the near completion of a program of plant expansion involving an expenditure to date of $15,000,000 by the three companies who are co-operating in the project. These plant expansions have provided a half-million square feet of floor space devoted to Diesel-electric locomotive construction and, when completed, will be producing a full line of switching and road Diesels in Canada, including the Diesel engines, electrical equipment and other component parts. The announcement was made by Sir Frederick Carson, executive vice-president, Montreal Locomotive Works, in the presence of H. M. Turner, president, Canadian General Electric Company, and H. G. Welsford, vice-president and general manager, Dominion Engineering Works, and was followed by a tour of inspection of the new Diesel locomotive assembly shop of the Montreal Locomotive Works.

Montreal Locomotive Works manufactures the chassis, trucks, cabs, and other component parts and assembles the locomotives. The locomotive company's new shop is about 700 ft. long. Here the chassis are built, trucks assembled, and the locomotive put together. At the present time the production of Diesel locomotive parts is somewhat scattered through other buildings in the plant. Gradually these operations are being brought together so that all Diesel production ultimately will be concentrated in buildings immediately adjoining the new assembly shop. In the future steam locomotives will be built only for export. About 275,000 sq. ft. of floor space of its total of 700,000 sq. ft. are now devoted to Diesel locomotive production.

The generators, motors, and other electrical parts are made at the Peterborough, Ont., plant of the Canadian General Electric Company. The Dominion Engineering Works for some time has been producing the in-line, eight-cylinder, 1,000-hp. Diesel engines for switching locomotives at its Lachine, Que., plant. It now has the V-type, 12-cylinder, 1,500-hp. engine for road freight and road switching locomotives under construction. On completion next spring of a second plant expansion, it will also build the V-type, 16-cylinder, 2,000-hp. engine for passenger locomotives. Continuing effort is being made to find Canadian suppliers to build the few parts which are still imported from the United States.

Near the end of one of the assembly lines in the Montreal Locomotive Works Diesel-electric locomotive shop where 15 1,500-hp. road switching locomotives are being assembled



With some few design changes, the locomotives built in Canada are counterparts of Alco-G.E. locomotives built in the United States. The expanded plants of the three companies have the capacity of one Diesel-electric locomotive every working day.

◆

MAGNUS CHEMICAL COMPANY.—The Magnus Chemical Company of Garwood, N. J., has acquired full control of the American K.A.T. Corporation. All manufacturing functions of American K.A.T.

J. D. Holmes

are being continued, and the main office of the corporation will be at Garwood. J. D. Holmes has been elected president of American K.A.T., succeeding Michael Stone. Mr. Holmes continues also as general manager of the Marine and Power Plant Service Division of Magnus. *Sidney G. Harris* has joined the Magnus company as sales engineer.

◆

PITTSBURGH SCREW & BOLT CORP.—*William N. Hoelzel* has been appointed assistant manager of railroad sales for the Gary Screw and Bolt division of the Pittsburgh Screw & Bolt Corp., Chicago. Mr. Hoelzel has been associated with the corporation since 1928 in a sales capacity.

◆

DEVILBISS COMPANY.—*William A. Delger*, former plant manager, has been appointed vice-president in charge of manufacturing, and *Don J. Peeps*, chief engineer, has been appointed vice-president in charge of engineering.

◆

AIR REDUCTION SALES COMPANY.—*J. H. Berryman* has been appointed assistant to the manager, technical sales division, of the Air Reduction Sales Company. Mr. Berryman, who will assist Scott D. Baumer, manager, technical sales division, will be responsible for the technical promotion and sales of equipment for the recently introduced Aircomatic Welding Process.

Mr. Berryman is a graduate of Johns Hopkins University (1935) where he re-

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  Cudahy Car Lines
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- New York Central R. R.
- General American Trans. Corp.
- Mather Stock Car Company
- New York, New Haven & Hartford R. R.
- Norfolk and Western R. R.
- North American Car Corp.
- Union Railway Co.
- Virginian Railway
- Wheeling and Lake Erie R. R.
- Baltimore & Ohio R. R.
- Delaware and Hudson R. R.
- Interstate Railroad Company
- Southern Railway System
- General Chemical Division
- Cities Service Oil Company
- Pennsylvania Railroad
- Western Maryland R. R.
- Delaware, Lackawanna & Western R. R.
- St. Louis-Southwestern Railway Co.
- Chicago, Rock Island and Pacific R. R.
- Central Railroad Co. of New Jersey
- Duluth, South Shore & Atlantic R. R.
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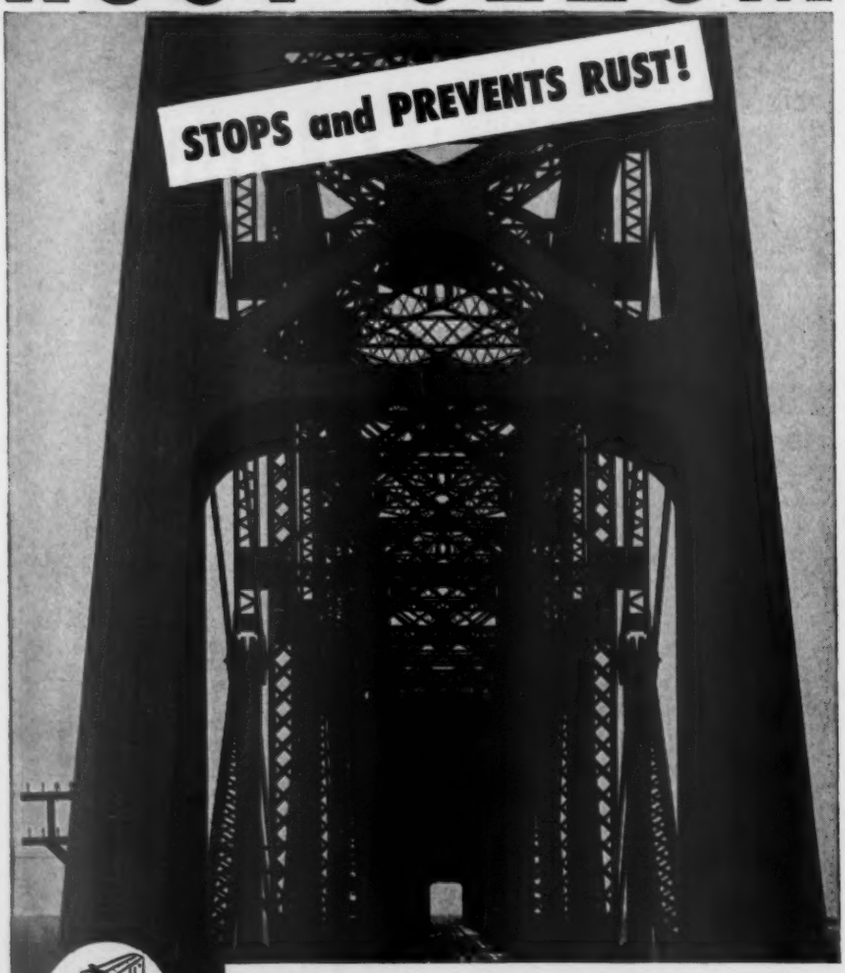
RUST-OLEUM



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An exclusive formula, RUST-OLEUM adds years of extra use to all metal surfaces. It cuts maintenance costs — indoors and out. RUST-OLEUM'S tough, pliable film dries to a firm finish that defies rain, snow, salt air, fumes, weathering, etc.

Where rust has already started, RUST-OLEUM can be applied effectively and economically. Scraping and wirebrushing to remove rust scale and dirt is all that is usually required. RUST-OLEUM merges the remaining rust into durable, rust-resisting coating that protects the metal against the elements. Use it in all your maintenance work on all exposed metal. Specify it on all new equipment or structures to be sure of maximum results at the lowest cost, with assurance of the best foundation coat.

Get the facts! . . . Write for complete data and recommended applications. Tell us your rust problems.

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ceived the degree of B.E. in mechanical engineering. He joined the Bethlehem Steel Company at Sparrows Point, Md., and was assistant lubrication engineer until 1940 when he entered the army as a second lieutenant. He emerged from service in 1946 with the rank of lieutenant-colonel, Signal Corps. He then joined Air Reduction and served in the technical sales division as machine welding specialist and assistant metallurgical engineer until his appointment as assistant to the manager of the division.

◆

CHERRY RIVET COMPANY.—The Cherry Rivet Company, Los Angeles, Calif., has established a new branch sales office and warehouse at 69 Harney road, Scarsdale, N. Y.

◆

ALBORG SUPPLY & EQUIPMENT CO.—The Alborg Supply & Equipment Co., manufacturers' representatives, has been organized to handle industrial purchas-

A. A. Borgading

ing services for the railroad, oil production, refining and marine construction fields. *Alvin A. Borgading*, former vice-president in charge of purchases for the American Car & Foundry Co., is president of the new company, with offices at 50 Church street, New York 7.

◆

AMERICAN BRAKE SHOE COMPANY.—*Paul L. McCulloch, Jr.*, has been transferred to the American Brake Shoe Company's Pittsburgh, Pa., district sales office, where he will serve as sales engineer for the firm's American manganese steel and electro-alloys divisions. He succeeds *M. A. Zeller*, who has resigned. Mr. McCulloch, formerly located in Rochester, N. Y., joined Brake Shoe in 1945 as an apprentice.

◆

BLACK & DECKER MANUFACTURING CO.—The Atlanta, Ga., factory sales and service branch of the Black & Decker Manufacturing Co. has been moved to 316 Techwood Drive, N.W., Atlanta 3.

◆

MINNEAPOLIS - HONEYWELL REGULATOR COMPANY.—*Fred Kaiser*, midwest regional manager of the Minneapolis-Honeywell Regulator Company at Chicago since 1942, has been appointed field sales manager, a newly-created position. Succeeding Mr. Kaiser in the midwest area is *Clarence L. Peterson*, formerly Pacific

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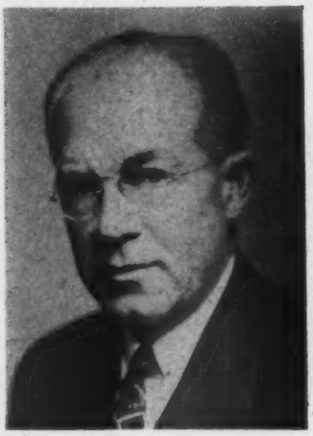
FAIRBANKS-MORSE
Opposed-Piston Diesel Power

regional manager at San Francisco, Calif. Mr. Peterson has been replaced by *Gavin S. Youngkin*, manager of the Los Angeles, Calif., branch since 1943, who will continue headquarters at Los Angeles. *Reginald C. Cushing*, regional air conditioning sales manager, has been advanced to branch manager at San Francisco.

◆

ELECTRIC STORAGE BATTERY COMPANY.—*S. W. Rolph*, executive vice-president of the Electric Storage Battery Company,



S. W. Rolph

Philadelphia, Pa., has been elected president to succeed *R. C. Norberg*, who has been elected chairman of the board.

AMERICAN WHEELABRATOR & EQUIPMENT CORP.—*J. Robert Bunch* has been appointed sales representative to assist J. D. Alexander in the Cleveland (Ohio) sales office of the American Wheelabrator & Equipment Corp., Mishawaka, Ind. For the past four years, Mr. Bunch has supervised the erection and servicing of Wheelabrator blast cleaning equipment and Dustube collectors in the Cleveland area.

◆

CLAUD S. GORDON COMPANY.—The Claud S. Gordon Company, 3000 South Wallace street, Chicago 16, has completed an arrangement with *Harry L. Campbell*, consultant on foundry practice, for the manufacture and sale of foundry testing equipment developed by Mr. Campbell. It will be marketed as the Gordon-Campbell foundry testing equipment.

◆

BRANDON EQUIPMENT COMPANY.—The Brandon Equipment Company, with offices at 332 South Michigan avenue, Chicago 4, has been organized by Jerry D. Brandon for supplying arch brick and oil-pan linings for steam locomotives, and for handling other railway devices. Mr. Brandon, who was formerly president of the Armerican Arch Company, will represent all the manufacturers that formerly supplied American Arch. The officers of the Brandon company are Mr. Brandon, president; Samuel MacClurkan, vice-president; Arthur F. Becker, vice-president; William D. Jones, assistant vice-president; Harry R. Cree, mechanical engineer; Elizabeth Burroughs, secretary; William E. Salisbury, service engineer at Chicago, and Thomas M. Ferguson, service engineer at New Haven. All were previously employed by American Arch.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*C. H. Beck*, vice-president of the Westinghouse Air Brake Company, has retired after over 44 years of service with the company.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Robert B. McColl*, president, a director and a member of the executive committee of the American Locomotive Company, has resigned. The offices of chairman of the board and president have been combined, and *D. W. Fraser*, chairman of the board, has been appointed to serve also as president.

◆

GARLOCK PACKING COMPANY.—*Phil Arnold*, vice-president of the Garlock Packing Company, has relinquished his duties and responsibilities in charge of the company's general sales department. Although thus retiring as head of the Garlock sales organization, Mr. Arnold will continue in a partially active capacity for an indefinite period as a vice-president of the company. *Louis Mohn*, who has been district sales manager at

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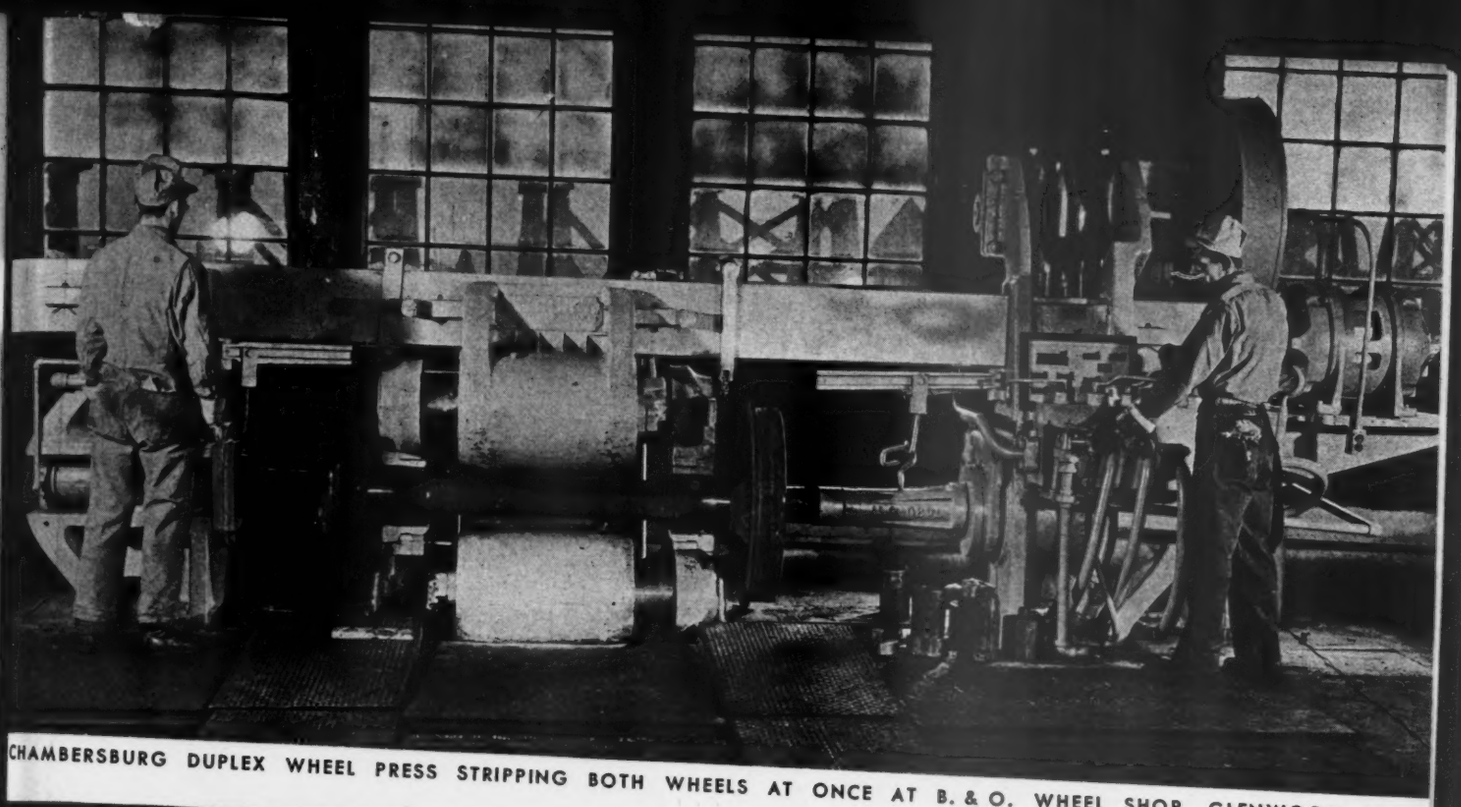
EX-CELL-O for PRECISION

HARDENED AND PRECISION GROUND STEEL PINS AND BUSHINGS

Railroad Division EX-CELL-O CORPORATION Detroit 6, Michigan



CHAMBERSBURG DUPLEX WHEEL PRESS STRIPPING BOTH WHEELS AT ONCE AT B. & O. WHEEL SHOP, GLENWOOD, PA.

The Chambersburg Duplex Car Wheel Press more than meets the requirements of the centralized car wheel shop

- **MINIMUM FLOOR-TO-FLOOR STRIPPING TIME...** The Chambersburg Duplex Car Wheel Press is designed for speed. Floor-to-floor stripping time is frequently clocked at 42 seconds—a speed unequalled by any other method.

- **CONTROLLED ACCURACY...** For mounting wheels to the standards defined in the Wheel and Axle Journal of the Association of American Railroads, there is no more accurately controlled pump and valve system than the Chambersburg Displacement Pump with selective control of its plungers.

Write for Bulletin 18-L-8

CHAMBERSBURG ENGINEERING COMPANY

CHAMBERSBURG PENNSYLVANIA

CHAMBERSBURG SINCE-1897

MECHANIZED

DIESEL PARTS CLEANING

SAVES TIME AND LABOR COSTS FOR THESE ROADS!

The Magnus Aja-Dip — 755 Method thoroughly cleans more parts in one-tenth the time normally required in a soak tank or vat . . . Eliminates up to 95% hand labor . . . Saves up to 60% in material cleaning cost.

MECHANIZE to SAVE!

The Magnus Aja-Dip with Magnus 755 decarbonizing solvent speeds cleaning of these average diesel parts as follows:

Heads	1½ hours
Liners	2 hours
Rods	20 minutes
Pistons	20 minutes
Blowers	20 minutes
Valves	15 minutes
Strainers	10 minutes
Misc. Parts	5 to 15 min.

Why go along with slow, costly, outdated cleaning methods? Write for complete data on the Magnus Aja-Dip—755 Method.

Railroad Division

MAGNUS CHEMICAL COMPANY • 77 South Ave., Garwood, N. J.

In Canada—Magnus Chemicals, Ltd.
4040 Rue Masson, Montreal 36, Que.

Magnus CLEANERS AND CLEANING EQUIPMENT

Representatives in all principal cities

Pittsburgh, Pa., since March 1929 and prior to that a sales representative in the Pittsburgh territory, has been appointed general sales manager at Palmyra, N. J. *Eugene G. Flannery*, heretofore a Garlock sales representative in the Pittsburgh territory, has been appointed district manager at Pittsburgh to succeed Mr. Mohn.

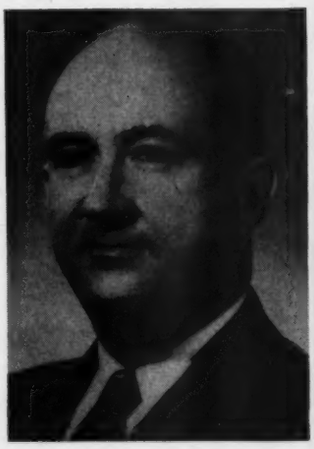
Mr. Arnold has been associated with the Garlock Packing Company for more than forty-one years. He joined that company in 1908 as a sales representative. Subsequently he has served as manager of the railroad sales department, district sales manager at Cleveland, Ohio, and since July 1, 1929, as vice-president in charge of sales with offices at 2111 Terminal Tower, Cleveland.

◆

JOHN A. ROEBLING'S SONS COMPANY.—*E. A. Trask*, former head of the San Francisco office of John A. Roebling's Sons Company of California, has assumed the duties of manager of sales of the company's Chicago corporation. *G. C. Bukowsky*, former manager of the Portland, Ore., branch, succeeds Mr. Trask.

◆

MANGANESE STEEL FORGE COMPANY.—*Percy H. Waller* has been appointed manager, Railway division, Manganese Steel Forge Company, Philadelphia, Pa., with headquarters in the Peoples Gas building, 122 S. Michigan avenue, Chicago.



Percy H. Waller

Mr. Waller was formerly associated with the Pullman Company for 37 years. He served in various branches of the business, more recently as assistant chief engineer and assistant to the chief maintenance officer.

◆

GREENVILLE STEEL CAR COMPANY.—*T. P. Irving* has become associated with the Greenville Steel Car Company as research development engineer.

Mr. Irving began his railroad career in July, 1901, as a mechanical draftsman, locomotive and car, for the Erie, and from August, 1902, to January, 1928, held such positions as draftsman, assistant chief draftsman, chief draftsman, and assistant mechanical engineer. When the Advisory Mechanical Committee was organized in November, 1929, Mr. Irving was appointed engineer of car construction for the Erie, the Chesapeake & Ohio, the Pere Marquette and the New York,

Left—Unloading bulk freight through drop-bottom door.
Below—Skidded load of steel. (Note 2 x 4 guide strips nailed to floor.)

The Milwaukee Road Builds Stronger, More Useful Drop-Bottom Gondolas with

NAILABLE STEEL FLOORING

In September 1948, the Milwaukee Road installed NAILABLE STEEL FLOORS in 25 new drop-bottom gondolas. There were two main reasons: (1) To make the cars more useful, capable of carrying *all* types of open-top lading; and (2) to lower maintenance costs by eliminating the need for frequent repairs and replacements.

Look at the Record

These cars have safely hauled (a) blocked and skidded loads that require nailing to the floor, including sheet steel, machinery, steel pipe and shapes, auto parts; (b) rough heavy freight, pig iron, steel billet crop ends, and other steel scrap; (c) bulk freight, including coal, sand and gravel.

Formed from tough corrosion-resistant N-A-X HIGH TENSILE steel—in a rigid channel design—NAILABLE STEEL FLOORS have high strength and durability, and have retained their nailability and overall flatness after impacts of magnets, clamshells, and heavy-freight loading.

NAILABLE STEEL FLOORING is readily adapted to drop-bottom construction, and is easily installed. Let us show you how you can make your drop-bottom gondolas into more useful, more durable, equipment with NAILABLE STEEL FLOORING.

PATENTS PENDING 49-SF-20

GREAT LAKES STEEL CORPORATION
Steel Floor Division • Penobscot Building • Detroit 26, Michigan
UNIT OF NATIONAL STEEL CORPORATION

FOR QUICK—ECONOMICAL

RERAILING of LOCOMOTIVES and RAILROAD CARS

DUFF-NORTON TRAVERSING BASES

Emergency rerailing of Diesel, steam, electric locomotives and railroad cars . . . is safe, simple and low in cost, with Duff-Norton Traversing Bases. Carried on wreck trains in units of two bases and two jacks, they eliminate the need for expensive cranes and are always available for any rerailing job.

Traversing Bases and Jacks are placed under load, for rerailing locomotives and cars.

QUICK DATA ON TRAVERSING BASES

Jack No.	Capacity Tons	Height Inches	Horizontal Travel Inches	Weight Pounds	Size of Plate Inches
39-TB	35	3¾	15	85	12 dia.
*40-TB	50	4	15	106	10 x 12
41-TB	50-75	4	20	140	14 dia.

*No. 40-TB can also be furnished for 26" horizontal movement on special order.

No. 40-TB furnished with wooden operating lever 1⅞" x 24" long.

Nos. 39-TB and 41-TB supplied with steel operating lever 1" x 24" long.

Freight car is lifted and moved horizontally until wheels are aligned with rails. Jacks are lowered to complete rerailing job.

DUFF-NORTON JACKS — STRENGTH, SAFETY, DEPENDABILITY — ESTABLISHED 1883

For Jacks Used With Traversing Bases . . . Write for Your Copy of Bulletin AD-4-R.

THE DUFF-NORTON MANUFACTURING CO.

Main Plant and General Offices, PITTSBURGH 30, PA. Canadian Plant, TORONTO 6, ONT.

"The House that Jacks Built"

Chicago & St. Louis, holding that position until his retirement in 1948. During World War II, he served for about one year as assistant director, Transportation Equipment division, War Production Board, at Washington, D. C. In 1941 he was appointed chairman of the Car Construction Committee of the Mechanical Division of the Association of American Railroads.

◆

COMBUSTION ENGINEERING - SUPERHEATER, INC.—*A. V. Adamson*, manager of the New York district sales office of Combustion Engineering-Superheater, Inc., for the past 25 years, has retired, but will continue to serve the company in a consulting capacity.

◆

B. F. GOODRICH COMPANY.—*Russell S. Colley* has been named manager of sales of Rivnuts and of Rivnut tools.

◆

OXWELD RAILROAD SERVICE COMPANY.—*Kenneth I. Thompson*, eastern sales manager of the Oxweld Railroad Service Company, a unit of *Union Carbide & Carbon Corp.*, has been appointed general sales manager.

Mr. Thompson was born in Bridgeport, Conn., in 1905, and after graduation from

Kenneth I. Thompson

Staunton Military Academy, Staunton, Va., started his business career with the Pennsylvania Pump & Compressor Co. as a salesman. He was later with the Fuller Lehigh Company, and before joining Oxweld in 1945, was associated with the Ingersoll-Rand Company, for a number of years. He was Western manager of the railroad department of Ingersoll-Rand prior to joining Oxweld.

◆

CHARLES R. ELLICOTT retired on January 1 as resident vice-president of the Westinghouse Air Brake Company at New York, but is continuing business activity as a manufacturers' associate, with office at 30 Broad street, New York. He will be associated with the *Ellcon Company*, manufacturers of rolling-stock specialties, and the *National Brake Company*, producers of power hand brakes.

Mr. Ellicott was born in Chicago on November 13, 1880, and was educated at the Hopkins Grammar School and the Sheffield Scientific School of Yale University, of which he is a graduate (1902)

WILLIAMS SUPERSOCKETS

WORLD'S MOST FLEXIBLE WRENCH SYSTEM The engineered flexibility of Williams "Supersockets" permits the combining of sockets, handles and accessories to create special wrenches for special jobs. Available in five different patterns, with drives ranging from 1/4" to 1" square, and with socket openings from 3/16" to 3-1/8". Write for Williams "Supersocket" Catalog A-50.

Set No. S-10 Complete in Metal Case, 36 Pieces
21 Sockets and 15 attachments

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OPEN END, BOX, ADJUSTABLE & RATCHET WRENCHES; DETACHABLE SOCKETS & SETS; IMPACT SOCKETS; TOOL HOLDERS; LATHE DOGS; "C" CLAMPS; CHAIN PIPE TONGS & VISES; FLANGE FACERS; REAMERS; SCREWDRIVERS; PUNCHES & CHISELS; SOFT FACED "NUPLASTEX" TIPPED HAMMERS; HOIST HOOKS; EYE BOLTS; ROD ENDS; CRANK & BALANCE HANDLES; THUMB SCREWS & NUTS;

J. H. WILLIAMS & CO., BUFFALO 7, N. Y. *Distributors Everywhere*

for QUICK, CLEAN, UNIFORM HEAT
at *LOW OPERATING COST*—

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SLOT-TYPE
FORGING
FURNACES

★ OIL OR GAS FIRED
★ SINGLE OR MULTIPLE SLOT TYPES

This furnace will maintain uniform neutral or reducing atmosphere for forging and welding which will avoid scale and decarburization. Construction features water, refractory or cast iron shields. Fire brick and insulating refractory brick lining with chrome refractory hearths are new features to reduce maintenance and operating costs and speed production.

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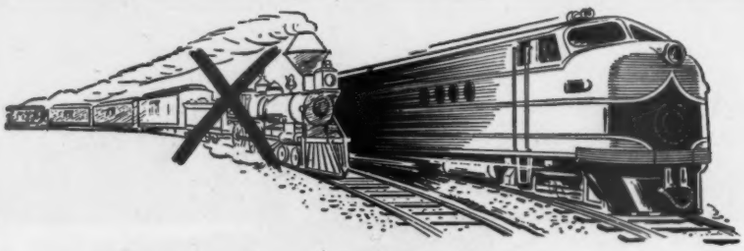
ENGINEERS & MANUFACTURERS OF INDUSTRIAL HEATING EQUIPMENT



PERMAG CLEANS

in this era of
MODERNIZATION
Railroads require
PERMAG
for Cleaning Operations

There was a time when ordinary soap and water with a scrubbing brush did much of the cleaning jobs on railroads. But not today! Big streamlined Diesel locomotives demand a faster, better, more effective cleaning system. PERMAG has been developed and for 28 years has met all cleaning requirements of America's leading railroads.

PERMAG has helped solve many a railroad cleaning problem. Let us send you more details.

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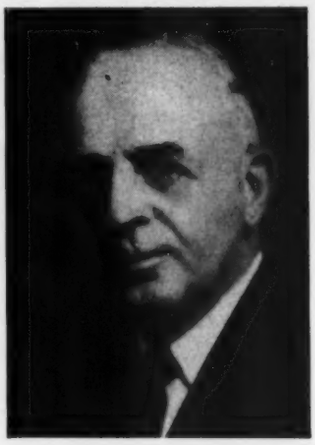
with the degree of B.S. in electrical engineering. After graduation he entered the service of Westinghouse Air Brake as an apprentice in its shops at Wilmerding, Pa., specializing in the brakes of electrically propelled vehicles. Thereafter



Charles R. Ellicott

he advanced through the engineering department of the company to the position of mechanical expert in the company's New York Office. He later became, respectively, representative, eastern manager and resident vice-president. Mr. Ellicott was the organizer of the Ellcon Company and is a director of the Safety Car Heating & Lighting Co. He has been active in committee and other work in a number of professional organizations, among them the American Society of Mechanical Engineers.

Obituary

B. FRANKLIN BALES, sales manager for Shakeproof, Inc., a division of the Illinois Tool Works, died on December 21 in the Evanston (Ill.) hospital.

◆

HARRISON HOBLITZELLE, chairman of the board of directors of the General Steel Castings Corporation, died on December 5, at his home in Ithan, Pa.

◆

MAURICE COSTELLO, sales engineer for the Flannery Bolt Company, Bridgeville, Pa., died on November 29. Mr. Costello had been associated with Flannery Bolt continuously since 1913.

PERSONAL MENTION

General

CHARLES G. POTTER, erecting shop foreman of the Missouri-Kansas-Texas Lines, at Denison, Tex., has been appointed mechanical engineer, with headquarters at Parsons, Kans. Mr. Potter was born on June 1, 1917, at Pine Bluff, Ark. He attended Arkansas State College and the University of Texas, re-

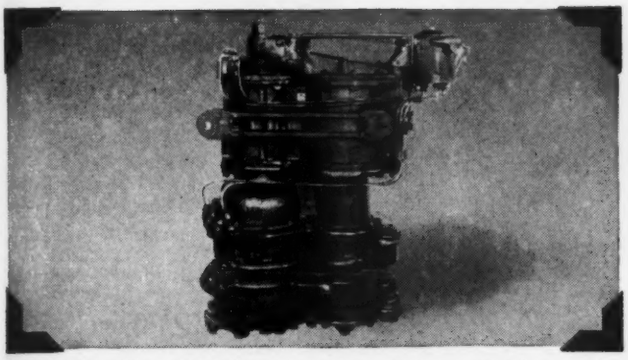
STANDARD ENGINEER'S REPORT

RPM CALOL

TEST DATA

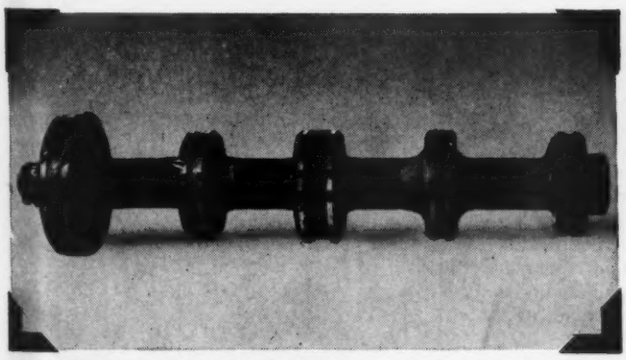
UNITS	Westinghouse Locomotive Air Compressor 8½" Cross Compound
LUBRICANT	Calol Air Pump Lubricant
TEST PERIOD	1 year
LUBRICATORS	Westinghouse F-1-A
ENGINE	M-137-151 — 2-8-8-2
CONDITION	Main Line Operation - 1% grade
LOCATION	Oroville, Calif. - Portola, Calif.
FIRM	Western Pacific R.R. Co.

TEST SHOWS NEW OIL SUCCESSFULLY LUBRICATES BOTH STEAM AND AIR ENDS OF AIR COMPRESSOR



Calol Air Pump Lubricant was used for a full year in a compressor like this, on a locomotive in regular service. It was supplied to both ends by removing the plug between the lubricator's two reservoirs.

This Air Discharge Valve was in the compressor during the test. As the photograph shows, at the end of a year's operation, it was free of carbonaceous deposits. Calol Air Pump Lubricant resists oxidation.



No lacquer or gum appeared on the Steam Differential Valve and wear was negligible. Valve rings and steam piston rings stayed clean and unstuck. Calol Air Pump Lubricant resists highest temperatures.

The Air Discharge Valve Cage was clear of excessive oxidation deposits, as were air pistons and their lands and rings. The use of Calol Air Pump Lubricant eliminates the necessity for frequent cleanup jobs.

REMARKS: Another compressor of the same size and type was operated on the opposite side of the locomotive. During the test, it was lubricated with a conventional type of Grade A valve oil. This compressor's valves and valve cages became filled with an appreciable amount of carbon. Also, considerable deposits of carbon and lacquer accumulated in air discharge passages.

Calol Air Pump Lubricant eliminates these conditions because it is a doubly-compounded oil. It is highly stable both in use and in storage. Its special compounds help resist oxidation by air, heat and moisture. They keep pistons, rings, ring-land areas, air passages, valves and other parts clean, and maintain a tough lubricant film on hot and cool spots alike in the most severe operation.

Trademark "Calol," Reg. U. S. Pat. Off.

STANDARD OF CALIFORNIA • San Francisco, Calif.
THE CALIFORNIA COMPANY • Denver, Colo.
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • Barber, New Jersey

ceiving the degree of B.S. in M.E. from the latter institution in 1941. His railroad service began with the St. Louis Southwestern in 1942 at Pine Bluff, as a special apprentice. In 1944 he entered the Transportation Corps of the United States Army as a private, subsequently serving in the European theater as a mechanical engineer with the 734th Railway Operating Battalion. He was discharged in 1946 as a captain. In 1947 he entered Katy service as a car draftsman at Parsons and was appointed erecting shop foreman at Denison in July, 1949.

R. A. SMITH, master mechanic of the Spokane division of the Great Northern at Spokane, Wash., has been appointed assistant to the general superintendent of motive power at St. Paul, Minn.

J. H. HERON, assistant to the general superintendent of motive power of the Great Northern at St. Paul, Minn., has been appointed superintendent of motive power at St. Paul.

JOHN L. ROBSON, superintendent of motive power for the Great Northern at St. Paul, Minn., has been appointed general superintendent of motive power at St. Paul. Mr. Robson, who was born in England, attended Montana State College and Yale University, and entered railroad service with the Northern Pacific at Livingston, Mont., in 1925. He subsequently joined the operating department of the G. N. and, following several assignments throughout the system, was appointed master mechanic at Grand Forks, N. D. In 1942 he became superintendent of motive power at St. Paul.

John L. Robson

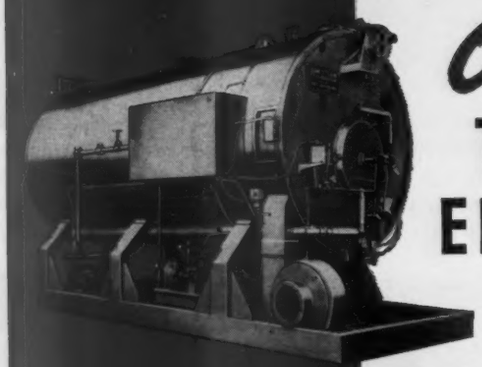
D. V. GONDER, assistant general manager, Western region, of the Canadian National, with headquarters at Winnipeg, Man., has been appointed general manager of the region, with headquarters at Winnipeg. Mr. Gonder was born on January 4, 1908, at Pingyao, Shansi, China. He attended Chefoo schools (China Inland Mission), Listowel and Stratford (Ont.) high schools, and night classes at the University of Toronto and McGill University. He entered C. N. service in 1925 as a machinist apprentice, Stratford shop. Subsequently, he served for a few months as a machinist with the American Canadian Company, Niagara Falls, Ont., returning to the C. N. as a draftsman at Toronto, Ont. He was appointed mechanical inspector at Toronto in 1933; assistant engineer in 1938, and erecting shop foreman at Stratford in July, 1938. From June, 1939, to April, 1944, Mr. Gonder was locomotive foreman, successively, at

Douglas V. Gonder

AMESTEAM GENERATOR

"The Railroad Boiler"

PRODUCT OF AMES IRON WORKS, OSWEGO, N. Y.



Over 80% THERMAL EFFICIENCY

Check These Advantages

- 80% Thermal Efficiency
- 100% automatic
- Abolishes boiler room labor
- Uses oil or gas fuel or a combination of both
- No smoke—no soot
- Takes up 1/3 the space of conventional boilers
- Suitable for multiple installations
- Delivered complete ready for service connections

Trouble-free, 100% automatic in operation, the AMESTEAM GENERATOR requires no chimney draft, only a simple vent to the atmosphere. Here is compact steam efficiency at its best. This unit takes up only one-third the space required by the conventional boiler. Important savings include elimination of boiler room labor and the fuel-saving advantages of a thermal efficiency of over 80%.

Ideal for low-pressure heat in station or shop, also for high pressure work for sand drying, Diesel de-icing and a host of other railroad applications.

Single units from 10 to 400 H.P. Suitable for multiple installations. Design pressure —15 to 200 lbs. Higher pressures on order.

See what this modern boiler can do for you. *Phone, write or wire.*

Exclusive Distributors to the Railroads

RAILROAD SUPPLY and EQUIPMENT, INC.

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FREIGHT CAR TRUCK SIDE FRAMES AND BOLSTERS
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ALL TYPES OF UNDERSTRUCTURE CASTINGS FOR FREIGHT CARS

A half-century of quality—
jealously guarded by chemistry,
metallography and X-Rays

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NEW YORK • CHICAGO • CLEVELAND • BALTIMORE • RICHMOND, VA. • MEXICO CITY, D. F.

Stratford, Ont., Mimico, and the Montreal (Que.) shops. He then became general superintendent of motive power and car equipment, Atlantic region, at Moncton, N. B. In January, 1949, he was appointed assistant general manager.

THOMAS G. MCFALL, superintendent of machinery of the Clinchfield at Erwin, Tenn., has retired. Mr. McFall was born on May 12, 1877, in Bedford County, Va. He was educated in the public schools of Roanoke, Va., and entered railroad service in 1895 with the Norfolk & Western and served in various capacities on that road until 1901, except for duty in the United States Army during the Spanish-American War. Subsequently, he served as a machinist, successively, on the Atchison, Topeka & Santa Fe, the Texas & Pacific, the Missouri Pacific, the Illinois Central, and the Chesapeake & Ohio. In 1906 he became engine-house foreman in the employ of the N. & W.; in October, 1917, was appointed general foreman of the Carolina, Clinchfield & Ohio (predecessor of the Clinchfield); in September, 1945, superintendent of shops, and in January, 1947, superintendent of machinery.

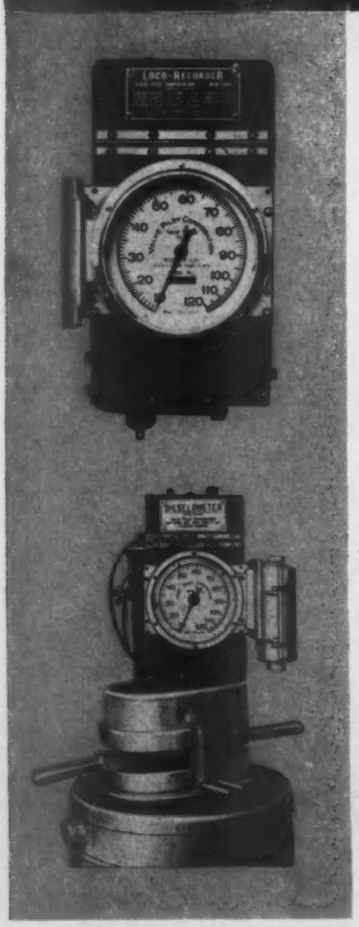
F. R. HOSACK, assistant chief mechanical officer of the Missouri Pacific, St. Louis, Mo., has joined the Chicago, Rock Island & Pacific, at Chicago, as mechanical assistant to vice-president—operation.

EDWIN B. DEVILBISS, manager of the insurance department of the Pennsylvania at Philadelphia, Pa., has retired. Mr. DeVilbiss was born at Fort Wayne, Ind., and is a graduate of Purdue University where he received the degree of mechanical engineer. He entered railroad service in 1908 as a special apprentice at Fort Wayne and rose through the motive-power department to become assistant engineer, master mechanic and superintendent of motive power. In 1929 he was appointed assistant stores manager at Philadelphia and in 1934 became manager of the insurance department.

FRANK D. SINEATH, assistant to chief of motive power and equipment of the Atlantic Coast Line at Wilmington, N. C., has been appointed assistant chief of motive power, with headquarters at Wilmington. Mr. Sineath was born on November 9, 1909, at Columbia, S. C. He entered the service of the Coast Line on May 12, 1941, as an electrician at Jacksonville, Fla. He became lead electrician there on April 9, 1942; seven months later Diesel gang foreman, and on November 1, 1944, Diesel department foreman. He was appointed general foreman on July 1, 1946; acting master mechanic at Florence, S. C., on March 1, 1948; master mechanic at Florence six months later; master mechanic at Wilmington on December 16, 1948, and assistant to chief of motive power and equipment in February, 1949.

Frank D. Sineath

E. P. GANGEWERE, assistant general manager of the Reading, has been elected vice-president, operating and maintenance. Mr. Gangewere was born at Bethlehem, Pa., on November 17, 1900, and educated at Chattanooga (Tenn.) high school. During 1917 and 1918 he worked as an apprentice in the machine shop of the Wheland Machine Co. at Chattanooga, and later attended Lehigh University, where he received the degree of mechanical engineer in 1922. Mr. Gangewere entered the service of



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RECORDERS

For More Efficient Operation

These accurate, dependable instruments help you realize the most from your Diesel investment. Chart your course with them — and *save.*

VALVE PILOT DIESEL SPEED RECORDERS—In all sections of the country—on every make of road Diesel, these reliable instruments are recording speeds with typical Valve Pilot precision and durability. Repeated calibration checks and service reports reveal their unfailing, lasting accuracy.

"DIESELOMETER" PRODUCTS, Valve Pilot *Operation* Recorders—Here in one "package" is the complete story of Diesel performance. In addition to *speeds,* these instruments record pertinent details of throttle, reverse and transition lever operation, dynamic braking, automatic train signal forestalling, etc.

Write for full particulars

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it's bigger!

THE ***diameter*** of the improved *Holland* **Volute** *Snubber Spring* has been increased from 4⅞" to 5½".

The volute spring bar has been made much thicker. These two improvements not only increase the friction area but lengthen the life of the improved *Holland* **Volute** *Snubber Spring*, Style A-7-A.

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BETTER MEASURE WITH LUFKIN

NOW—
ALL 3 "MIKES"
ARE *CHROME-CLAD* TO
HELP YOU *SEE RIGHT—*
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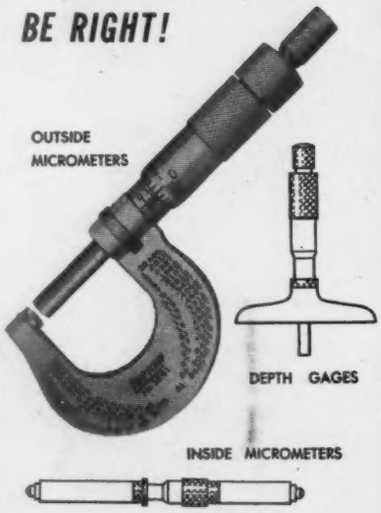

Now you can get all 3 types of *Lufkin "Mikes"* with the special *Chrome-Clad* finish that assures accurate measuring. In blinding sun, or dim shop corner, the *Lufkin Chrome-Clad* finish absorbs disturbing reflections...resists both rust and wear. Black markings stand out razor-sharp against the chrome-white background. Improve your accuracy and improve the standard of your work with these *Chrome-Clad* precision tools. It's a proved fact that you'll get "Better Measure With Lufkin"—see your nearest dealer soon.

Write Dept. RM for the fascinating, educational booklet entitled, "The Amazing Story of Measurement." Please enclose 10c (no stamps) to cover mailing and handling.

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THE LUFKIN RULE CO.

Saginaw, Mich. New York City Barrie, Ontario

the Reading in 1922 as a special apprentice on the staff of the assistant superintendent of motive power and later the same year became motive power inspector. In 1925 he was appointed mechanical supervisor. From 1927 to 1933 he served as enginehouse foreman at Saucon Creek, Bethlehem, and assistant

E. Paul Gangewere

master mechanic at Philadelphia, Pa. In 1933 he was appointed assistant superintendent of the locomotive shops at Reading, Pa.; on January 1, 1939, assistant superintendent of motive power and rolling equipment; on January 1, 1942, superintendent of motive power and rolling stock, and on March 10, 1949, assistant general manager.

Electrical

WILLIAM LANDESS has been appointed chief engineer of the Chicago Union Station Company, with headquarters at Chicago. Mr. Landess was born in Chicago on July 17, 1894. He attended Crane Technical High School, Chicago, and night school at Lewis Institute of Technology, where he studied electrical engineering and steam power-plant operation. He began his railroad career in February, 1913, as a construction electrician with the Chicago, Burlington & Quincy. From 1914 to 1917 he was engaged in general electrical construction work, subsequently returning to the Burlington to serve successively as construction electrician, electrical foreman, electrical estimator and inspector. In October, 1922, he joined Chicago Union Station as chief electrician. In 1927 he was appointed assistant mechanical superintendent, serving also on special assignments. In July, 1945, he became mechanical and construction superintendent.

ROLAND GOOCH has been appointed assistant superintendent of power at Grand Central Terminal, New York, and on the Electric divison of the New York Central. Mr. Gooch was born at Eatonton, Ga., in 1898 and received degrees in mechanical and electrical engineering at the Georgia Institute of Technology. He entered the service of the N.Y.C. in 1921 as clerk-statistician in the power department at Grand Central; became special staff engineer in 1922 and assistant engineer in the power department in 1931.

ROSWELL J. OSBORN has been appointed superintendent of power at Grand Central Terminal, New York, and on the Electric division of the New York Central. Mr. Osborn, who was born in 1902 at Kalamazoo, Mich., is a graduate of the University of Vermont with a degree in mechanical engineering. He entered the service of the N.Y.C. in 1936 as an air-conditioning inspector at Grand Central. He was appointed refrigeration foreman in 1938, assistant supervisor of service plants in 1941, supervisor in 1944, and assistant superintendent of power on March 1, 1949.

Master Mechanics And Road Foremen

R. C. HEMPSTEAD, master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, at LaCrosse, Wis., and an employee of the Milwaukee since 1914, has retired.

J. W. TRAGNITZ, assistant master mechanic at the Markham shops of the Illinois Central, Hazel Crest, Ill., has been appointed master mechanic, with headquarters at Vicksburg, Miss.

W. B. GAGE, assistant master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, has assumed jurisdiction over locomotive matters on the La-Crosse and River division.

P. J. BIGGAN, formerly road foreman on the Missouri Pacific, has been appointed master mechanic of the Western division of the Chicago, Rock Island & Pacific, with headquarters at Goodland, Kan.

W. F. HALLINAN, traveling engineer of the Great Northern at Hillyard, Wash., has been appointed master mechanic of the Spokane Division of the road, with headquarters at Spokane, Wash.

C. A. CARLSON, general foreman in Cedar Rapids (Iowa) shops of the Chicago, Rock Island & Pacific, has been appointed master mechanic of the Oklahoma division, with headquarters at El Reno, Okla.

W. F. KLINE has been appointed road foreman of the Chicago, Rock Island & Pacific, with headquarters at Goodland, Kan. Mr. Kline was previously master mechanic of the road's Western division.

EDWARD L. BROWN, assistant master mechanic of the Baltimore & Ohio, New York Terminal Region, has been appointed master mechanic of the region, with headquarters in Staten Island, N. Y.

Car Department

C. A. TAYLOR, chief car inspector for the Chicago, Rock Island & Pacific at Chicago, has been appointed assistant to the superintendent of the car department at Chicago.

Shop and Enginehouse

J. H. KASMEIER, master mechanic of the Oklahoma division of the Chicago, Rock Island & Pacific at El Reno, Okla., has been transferred to the Cedar Rapids, Iowa, shops as general foreman.